R&S®FSWP
Phase Noise Analyzer
User Manual

1177.5633.02 ─ 02

Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual describes the following R&S®FSWP models with firmware version 1.10 or higher:

- R&S®FSWP8 (1322.8003K08)
- R&S®FSWP26 (1322.8003K26)

In addition, the following options are described:

- R&S FSWP-B24 (1325.3725.08)
- R&S FSWP-B24 (1325.3725.26)
- R&S FSWP-B60 (1322.9800.08)
- R&S FSWP-B60 (1322.9800.26)
- R&S FSWP-B64 (1322.9900.26)
- R&S FSWP-K4 (1325.5034.02)
- R&S FSWP-K33 (1325.5040.02)

The software contained in this product makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®FSWP is abbreviated as R&S FSWP. R&S MultiView is abbreviated as MultiView. Products of the R&S®SMW family, e.g. R&S®SMW200A, are abbreviated as R&S SMW.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

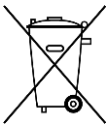
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF Power
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Caution ! Hot surface		Alternating current (AC)
	Protective conductor terminal To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth		Direct/alternating current (DC/AC)
	Earth (Ground)		Class II Equipment to identify equipment meeting the safety requirements specified for Class II equipment (device protected by double or reinforced insulation)
	Frame or chassis Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
In the product documentation, the word ATTENTION is used synonymously.

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution degree 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the mains-supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC 60950-1 / EN 60950-1 or IEC 61010-1 / EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

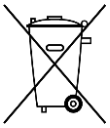
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.

Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.

Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.

Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.

2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

Quality management and environmental management

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde&Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde&Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear customer,
You have decided to buy a Rohde&Schwarz product. This product has been manufactured using the most advanced methods. It was developed, manufactured and tested in compliance with our quality management and environmental management systems. Rohde&Schwarz has been certified, for example, according to the ISO 9001 and ISO 14001 management systems.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,
Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests de ce produit ont été effectués selon nos systèmes de management de qualité et de management environnemental. La société Rohde&Schwarz a été homologuée, entre autres, conformément aux systèmes de management ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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1.1 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S FSWP for the first time.

WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury, or damage.

- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" at the beginning of this manual or on the documentation CD-ROM, in addition to the safety instructions in the following sections. Notice that the data sheet may specify additional operating conditions.

NOTICE

Risk of instrument damage

Note that the general safety instructions also contain information on operating conditions that will prevent damage to the instrument. The instrument's data sheet may contain additional operating conditions.

NOTICE

Risk of electrostatic discharge (ESD)

Electrostatic discharge (ESD) can cause damage to the electronic components of the instrument and the device under test (DUT). ESD is most likely to occur when you connect or disconnect a DUT or test fixture to the instrument's test ports. To prevent ESD, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

For details, refer to the safety instructions delivered in electronic format on the documentation CD-ROM.

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can cause damage to the instrument and to connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

EMI impact on measurement results

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated electromagnetic interference (EMI):

- Use suitable shielded cables of high quality. For example, use double-shielded RF and LAN cables.
- Always terminate open cable ends.
- Note the EMC classification in the data sheet.

- Unpacking and Checking the Instrument 12
- Accessory List 13
- Placing or Mounting the Instrument 13
- Connecting the AC Power 15
- Switching the Instrument On and Off 15
- Performing a Self-Alignment and a Selftest 16
- Checking the Supplied Options 17

1.1.1 Unpacking and Checking the Instrument

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

NOTICE

Risk of damage during transportation and shipment

Insufficient protection against mechanical and electrostatic effects during transportation and shipment can damage the instrument.

- Always make sure that sufficient mechanical and electrostatic protection is provided.
- When shipping an instrument, the original packaging should be used. If you do not have the original packaging, use sufficient padding to prevent the instrument from moving around inside the box. Pack the instrument in antistatic wrap to protect it from electrostatic charging.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.

The **carrying handles** at the front and side of the casing are designed to lift or carry the instrument. Do not apply an excessive external force to the handles.

Observe the information on transporting heavy instruments in the basic safety instructions included at the front of the printed manual and on the supplied CD ROM.

Packing material

Retain the original packing material. If the instrument needs to be transported or shipped at a later date, you can use the material to protect the control elements and connectors.

1.1.2 Accessory List

The instrument comes with the following accessories:

- Power cable
- Printed Getting Started manual
- "R&S FSWP User Documentation" CD-ROM

1.1.3 Placing or Mounting the Instrument

The R&S FSWP is designed for use under laboratory conditions, either on a bench top or in a rack.

Bench Top Operation

If the R&S FSWP is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

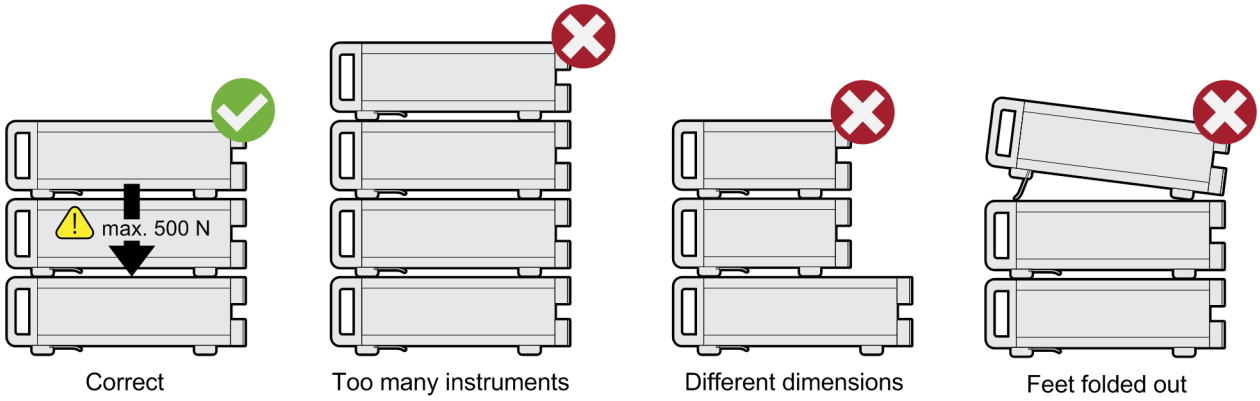
CAUTION

Risk of injury and instrument damage if stacking instruments

A stack of instruments may tilt over and cause injury. Furthermore, the instruments at the bottom of the stack may be damaged due to the load imposed by the instruments on top.

Observe the following instructions when stacking instruments:

- Never stack more than three instruments. If you need to stack more than three instruments, install them in a rack.
- The overall load imposed on the lowest instrument must not exceed 500 N.
- All instruments must have the same dimensions (width and length).
- If the instruments have foldable feet, fold them in completely.

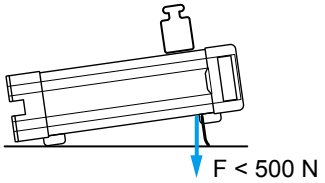


CAUTION

Risk of injury if feet are folded out

The feet may fold in if they are not folded out completely or if the instrument is shifted. This may cause damage or injury.

- Fold the feet completely in or completely out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.
- When the feet are folded out, do not work under the instrument or place anything underneath.
- The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.



Rackmounting

The R&S FSWP can be installed in a rack using a rack adapter kit (order no. see data sheet). The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage in a rack

An insufficient airflow can cause the instrument to overheat, which may disturb the operation and even cause damage.

Make sure that all fan openings are unobstructed, that the airflow perforations are unimpeded, and that the minimum distance from the wall is 10 cm.

1.1.4 Connecting the AC Power

In the standard version, the R&S FSWP is equipped with an AC power supply connector. The R&S FSWP can be used with different AC power voltages and adapts itself automatically to it. Refer to the datasheet for the requirements of voltage and frequency. The AC power connector is located on the rear panel of the instrument.

For details on the connector refer to chapter 2.2.2, "AC Power Connector and Main Power Switch", on page 41.

► Connect the R&S FSWP to the AC power supply using the supplied power cable. Since the instrument is assembled in line with the specifications for safety class EN61010, it may only be connected to an outlet that has a ground contact.

1.1.5 Switching the Instrument On and Off

Switching the instrument on

► Press the AC power switch on the rear panel to position "I".

The instrument is supplied with AC power. After booting, the instrument is ready for operation. A green LED above the POWER key indicates this.
An orange LED indicates the instrument is in standby mode

Warm-up time for OCXO

When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet). No warm-up time is required when starting from standby mode.

Switching the instrument off

1. Press the POWER key on the front panel.

   The R&S FSWP switches to standby mode.

2. Set the AC power switch on the rear panel to position "O", or disconnect the instrument from the AC power supply.

   The R&S FSWP changes into off mode.

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data may be lost.

Press the Power key first to shut down the application properly.

1.1.6 Performing a Self-Alignment and a Selftest

During instrument start, the installed hardware is checked against the current firmware version to ensure the hardware is supported. If not, an error message is displayed ("WRONG_FW") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails.

(For details refer to the R&S FSWP User Manual).

Furthermore, it may be necessary to align the data to a reference source by performing a self-alignment when strong temperature changes occur.

Operating temperature

Before performing this functional test, make sure that the instrument has reached its operating temperature (for details, refer to the data sheet).

A message in the status bar ("Instrument warming up...") indicates that the operating temperature has not yet been reached.

Performing a self-alignment

1. Press the SETUP key.
2. Press the "Alignment" softkey.
3. Select the "Start Self-Alignment" button in the "Alignment" dialog box.

   Once the system correction values have been calculated successfully, a message is displayed.

To display the alignment results again later

- Press the SETUP key.
- Press the "Alignment" softkey.

Performing a selftest

The selftest does not need to be repeated every time the instrument is switched on. It is only necessary when instrument malfunction is suspected.

1. Press the SETUP key.
2. Press the "Service" softkey.
3. Switch to the "Selftest" tab in the "Service" dialog box.
4. Select the "Start Selftest" button.

   Once the instrument modules have been checked successfully, a message is displayed.

1.1.7 Checking the Supplied Options

The instrument may be equipped with both hardware and firmware options. In order to check whether the installed options correspond to the options indicated on the delivery note, proceed as follows.

1. Press the SETUP key.
2. Press the "System Config" softkey.
3. Switch to the "Versions + Options" tab in the "System Configuration" dialog box.

   A list with hardware and firmware information is displayed.
4. Check the availability of the hardware options as indicated in the delivery note.

1.2 Windows Operating System

The instrument contains the Microsoft Windows operating system which has been configured according to the instrument's features and needs. Changes in the system setup are only required when peripherals like keyboard or a printer are installed or if the network configuration does not comply with the default settings. After the R&S FSWP is started, the operating system boots and the instrument firmware is started automatically.

To ensure that the instrument software functions properly, certain rules must be adhered to concerning the operating system.

NOTICE

Risk of causing instrument unusability

The instrument is equipped with the Microsoft Windows operating system. Additional software can therefore be installed on the instrument. The use and installation of additional software may impair instrument function. Thus, run only programs that Rohde & Schwarz has tested for compatibility with the instrument software.

The drivers and programs used on the instrument under Microsoft Windows have been adapted to the instrument. Existing instrument software must always be modified using only update software released by Rohde & Schwarz.

The following program packages have been tested:

- Symantec Endpoint Security – Virus-protection software
- FileShredder - for reliable deletion of files on the hard disk

1.2.1 Virus Protection

Users must take appropriate steps to protect their instruments from infection. Beside the use of strong firewall settings and regularly scanning any removable storage device used with a Rohde & Schwarz instrument, it is also recommended that anti-virus software be installed on the instrument. While Rohde & Schwarz does NOT recommend running anti-virus software in the background ("on- access" mode) on Windows-based instruments, due to potentially degrading instrument performance, it does recommend running it during non-critical hours.

For details and recommendations, see the Rohde & Schwarz White Paper 1DC01: Malware Protection.

1.2.2 Service Packs and Updates

Microsoft regularly creates security updates and other patches to protect Windows-based operating systems. These are released through the Microsoft Update website and associated update server. Instruments using Windows, especially those that connect to a network, should be updated regularly.

For details and recommendations, see the Rohde & Schwarz White Paper 1DC01: Malware Protection.

1.2.3 Login

Microsoft Windows requires that users identify themselves by entering a user name and password in a login window. By default, the R&S FSWP provides two user accounts:

- **"Instrument"**: an administrator account with unrestricted access to the computer/ domain

- **"NormalUser"**: a standard user account with limited access

Automatic login

For the administrator account, an automatic login function is active by default. If activated, login is carried out automatically for the administrator (with full access) in the background when the R&S FSWP is started, without having to enter a password. This function is active until you explicitely deactivate it or change the password.

For information on how to deactivate or re-activate the automatic login, refer to chapter 1.2.3.1, "The Automatic Login Function", on page 19.

Passwords

For all default user accounts, the initial password is *894129*. Note that this password is very weak, and it is recommended that you change the password for both users after initial login. You can change the password in Windows 7 for any user at any time via "Start > Control Panel > User Accounts".

Changing the password and use of auto-login function

Note that when you change the default passwords, the default auto-login function no longer works! You must reactivate it manually as described in "Reactivating the automatic login function" on page 20.

1.2.3.1 The Automatic Login Function

When shipped, the instrument is already configured to automatically log on under Microsoft Windows using the default administrator account ("Instrument") and password.

Deactivating the automatic login function

To deactivate the automatic login function, perform the following steps:

1.

   Select the "Windows" icon in the toolbar to access the operating system of the R&S FSWP (see also chapter 1.2.4, "Accessing the Start Menu", on page 20).

2. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.

3. Enter the command `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG`.

4. Press the ENTER key to confirm.
   The automatic login function is deactivated. The next time you switch on the instrument, you are prompted to enter your user name and password before the firmware is started.

Adapting the automatic login function to a new password

If you change the "Instrument" user's (administrator's) password, which is used during automatic login, this function no longer works. You must then adapt the settings for the command that activates the auto login function first.

1. Open the `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG` file in any text editor (e.g. Notepad).
2. In the line `"DefaultPassword"="894129"`, replace the default password (`894129`) by the new password which is to be used for automatic login.
3. Save the changes to the file.

Reactivating the automatic login function

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command `C:\R_S\INSTR\USER\AUTOLOGIN.REG`.
3. Press the ENTER key to confirm.
   The automatic login function is reactivated. It will be applied the next time the instrument is rebooted.

Switching users when using the automatic login function

Which user account is used is defined during login. However, you can also switch the user account to be used when the automatic login function is active.

► In the "Start" menu, select the arrow next to the "Shut down" button and then "Log off".

The "Login" dialog box is displayed, in which you can enter the different user account name and password.

1.2.4 Accessing the Start Menu

All necessary system settings can be defined in the "Start > Control Panel" menu (for required settings refer to the Microsoft Windows documentation and to the hardware description).

1.3 Connecting USB Devices

The USB interfaces of the R&S FSWP allow you to connect USB devices directly to the instrument. This number can be increased as necessary by using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S FSWP.

The following list shows various USB devices that can be useful:

- Memory stick for easy transfer of data to/from a computer (e.g. firmware updates)

- CD-ROM drives for easy installation of firmware applications
- Keyboard or mouse to simplify the entry of data, comments, file names, etc.
- Printer for printing out measurement results

Installing USB devices is easy under Windows, because all USB devices are plug&play. After a device is connected to the USB interface, the operating system automatically searches for a suitable device driver.

If Windows does not find a suitable driver, it will prompt you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is subsequently disconnected from the R&S FSWP, Windows immediately detects the change in hardware configuration and deactivates the corresponding driver.

All USB devices can be connected to or disconnected from the instrument during operation.

Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, Windows informs you that the device is ready to use. The device is made available as a new drive and is displayed in Windows Explorer. The name of the drive depends on the manufacturer.

Connecting a keyboard

The keyboard is detected automatically when it is connected. The default input language is English – US.

Select "Start > Control Panel > Clock, Language, and Region > Change keyboards or other input methods" to configure the keyboard properties. To access the Windows operating system, press the Windows key on the external keyboard.

Connecting a mouse

The mouse is detected automatically when it is connected.

Select "Start > Control Panel > Devices and Printers > Mouse" to configure the mouse properties. To access the Windows operating system, press the Windows key on the external keyboard.

Connecting a printer

When printing a file, the instrument checks whether a printer is connected and turned on and whether the appropriate printer driver is installed. If required, printer driver installation is initiated. A printer driver needs to be installed only once.

To install a printer, select "Start > Control Panel > Devices and Printers > Add a printer". To access the Windows operating system, press the Windows key on the external keyboard.

You can load updated and improved driver versions or new drivers from an installation disk, USB memory stick or another external storage medium. If the instrument is integrated in a network, you can also install driver data stored in a network directory.

Select "Start > Control Panel > Devices and Printers > Device Manager > Update Device drivers" to install the driver.

1.4 Connecting an External Monitor

You can connect an external monitor (or projector) to the DVI or DISPLAY PORT connector on the instrument's rear panel (see also chapter 2.2.3, "DisplayPort and DVI", on page 41).

Screen resolution and format

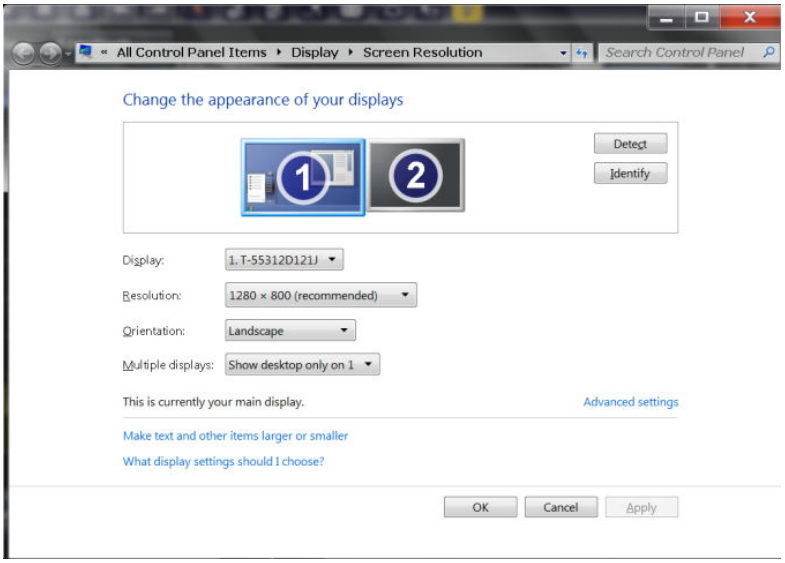
The touchscreen of the R&S FSWP is calibrated for a 16:10 format. If you connect a monitor or projector using a different format (e.g. 4:3), the calibration will not be correct and the screen will not react to your touch actions properly.

The touchscreen has a screen resolution of 1280x800 pixels. Most external monitors have a higher screen resolution. If the screen resolution of the monitor is set higher than the instrument's resolution, the application window uses an area of 1280x800 pixels on the monitor display. For full screen display, adjust the monitor's screen resolution.

The R&S FSWP supports a minimum resolution of 1280x768 pixels.

1. Connect the external monitor to the R&S FSWP.
2. Press the SETUP key.
3. Press the "Display" softkey.
4. Select the "Configure Monitor" tab in the "Display" dialog box.

   The standard Windows "Screen Resolution" dialog box is displayed.



5. If necessary, change the screen resolution to be used. Consider the information in the note above.
6. Select the instrument to be used for display:
   - "Display 1": internal monitor only
   - "Display 2": external monitor only
   - "Duplicate": both internal and external monitor
7. Tap "Apply" to try out the settings before they are accepted permanently, then you can easily return to the previous settings, if necessary.
8. Select "OK" if the settings are suitable.

1.5 Setting Up a Network (LAN) Connection

The R&S FSWP is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator and the Windows firewall configuration is adapted accordingly, the interface can be used, for example:

- To transfer data between a controlling device and the test device, e.g. in order to run a remote control program.
  See chapter "Remote Control"
- To access or control the measurement from a remote computer using the "Remote Desktop" application (or a similar tool)
- To connect external network devices (e.g. printers)
- To transfer data from a remote computer and back, e.g. using network folders

This section describes how to configure the LAN interface. It includes the following topics:

- chapter 1.5.1, "Connecting the Instrument to the Network", on page 23
- chapter 1.5.2, "Assigning the IP Address", on page 24

LXI

The R&S FSWP complies with LXI Class C. LXI gives you direct access to the LAN settings described below.

1.5.1 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.

- A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol. An IP address has to be assigned to the instrument and the computer, see chapter 1.5.2, "Assigning the IP Address", on page 24.

NOTICE

Risk of network failure

Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

► To establish a non-dedicated network connection, connect a commercial RJ-45 cable to one of the LAN ports.
To establish a dedicated connection, connect a (crossover) RJ-45 cable between the instrument and a single PC.

If the instrument is connected to the LAN, Windows automatically detects the network connection and activates the required drivers.

The network card can be operated with a 1 GBit Ethernet IEEE 802.3u interface.

1.5.2 Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
- If the network does not support DHCP, or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network errors

Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

1.5.3 Using computer names

In a LAN that uses a DNS server (Domain Name System server), each PC or instrument connected in the LAN can be accessed via an unambiguous computer name instead of the IP address. The DNS server translates the host name to the IP address. This is especially useful when a DHCP server is used, as a new IP address may be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, but this name can be changed.

The default instrument name is a non-case-sensitive string with the following syntax:

<Type><variant>-<serial_number>

The serial number can be found on the rear panel of the instrument. It is the third part of the device ID printed on the bar code sticker:

1.5.4 Changing the Windows Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. Rohde & Schwarz highly recommends the use of the firewall on your instrument. Rohde & Schwarz instruments are shipped with the Windows firewall enabled and preconfigured in such a way that all ports and connections for remote control are enabled.

For more details on firewall configuration, see the Rohde & Schwarz White Paper 1DC01: Malware Protection.

Note that changing firewall settings requires administrator rights.

1.6 Setting the Date and Time

Users with administrator rights can set the date and time for the internal real time clock as follows:

Opening the Date and Time Properties dialog box

1. Press the SETUP key.
2. Press the "Display" softkey.
3. Select the "General" tab in the "Display" dialog box.

4. Press the "Set Date and Time" button to open the standard Windows "Date and Time Properties" dialog box.
5. If necessary, toggle the "Date and Time Format" between German (DE) and US.

   After you have made a change and closed the dialog box, the new date and time is also adopted by the instrument.

2 Instrument Tour

On the instrument tour, you can learn about the different control elements and connectors on the front and back panel of the R&S FSWP.

- The Front Panel 27
- The Rear Panel 39

2.1 The Front Panel

This chapter describes the front panel, including all function keys and connectors.

Fig. 2-1: Front panel of the R&S FSWP

1 = Display (touchscreen)
2 = Power key
3 = System control keys
4 = USB 2.0 interfaces
5 = Power sensor connector
6 = Probe power connector
7 = DC power connectors
8 = Baseband connectors
9 = Signal source output (optional)
10 = External mixer ports (optional)
11 = Noise source control
12 = RF input
13 = Trigger in- and output
14 = Keypad
15 = Navigation control
16 = Function keys

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

- Display (Touchscreen)..... 28
- Power Key..... 33
- System Control Keys..... 33
- The Function Keys..... 34
- The Keypad..... 35
- Navigation Control..... 36
- RF Input (50 Ω)..... 37
- Signal Source Output..... 38
- USB Ports..... 38
- Power Sensors..... 38
- Probe Power Connector (3 Pins)..... 38
- Noise Source Control..... 39
- Trigger Input and Output..... 39
- DC Power Supply..... 39

2.1.1 Display (Touchscreen)

The touchscreen on the front panel of the R&S FSWP displays the measurement results. Additionally, the screen display provides status and setting information and allows you to switch between various measurement tasks. The screen is touch-sensitive, offering an alternative means of user interaction for quick and easy handling of the instrument.

NOTICE

Risk of touchscreen damage during operation

The touchscreen may be damaged by inappropriate tools or excessive force.

Observe the following instructions when operating or cleaning the touchscreen:

- Never touch the screen with ball point pens or other pointed objects with sharp edges.
- It is recommended that you operate the touchscreen by finger only.
  As an alternative, you may use a stylus pen with a smooth soft tip.
- Never apply excessive force to the screen. Touch it gently.
- Never scratch the screen surface, for example with a finger nail.
  Never rub it strongly, for example with a dust cloth.

1 = Toolbar: contains general functionality of the firmware (print, save etc.).
2 = Channel tabs: each tab contains a measurement channel.
3 = Channel bar: shows measurement settings and allows you to change those settings easily.
4 = Result display: contains the measurement results.
5 = Window title bar: contains diagram-specific (trace) information.
6 = Status bar: contains system messages, progress bar and date and time.
7 = Input field.
8 = Diagram footer: contains diagram-specific information.
9 = Softkeys: provide access to measurement functions.

A touchscreen is a screen that is touch-sensitive, i.e. it reacts in a specified way when a particular element on the screen is tapped by a finger or a pointing device, for example. Any user interface elements that can be clicked on by a mouse pointer can also be tapped on the screen to trigger the same behavior, and vice versa.

Using the touchscreen, the following tasks (among others) can be performed by the tap of your finger:

- Changing a setting
- Changing the display
- Moving a marker
- Zooming into a diagram
- Selecting a new evaluation method
- Scrolling through a result list
- Saving or printing results and settings

To imitate a right-click by mouse using the touchscreen, for example to open a context-sensitive menu for a specific item, press the screen for about 1 second.

2.1.1.1 Toolbar

The icons in the toolbar provide access to general functions.

You can hide the toolbar display, for example when using remote control, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items"). See the R&S FSWP User Manual for details.

	Windows: opens the Windows "Start" menu and task bar.
	Open: opens a file from the instrument or an external device ("Save/Recall" menu).
	Store: stores data on the instrument or an external device ("Save/Recall" menu).
	Print: defines print settings ("Print" menu).
	Undo: reverts last operation
	Redo: repeats previously reverted operation
	Select: the cursor can be used to select (and move) elements in the display (markers, lines etc.).

	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area.
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram.
	Zoom off: displays the diagram in its original size.
	SmartGrid: activates "SmartGrid" mode to configure the screen layout.
	Sequencer: opens the "Sequencer" menu to perform consecutive measurements.
	DC Power: turns the DC power output on and off.
	DC Configuration: provides quick access to configure the main parameters for DC power supply.
	Signal Source: turns the optional signal source output on and off. (Available when the optional signal source output is installed.)
	RF Config: provides quick access to configure the main parameters of the signal source. (Available when the optional signal source output is installed.)
	Help (+ Select): allows you to select an element for which context-specific help is displayed.
	Help: displays context-sensitive help topic for currently selected element.
	Print immediately: prints the current display (screenshot) as configured.
In "SmartGrid" mode only:	
	Close: Exit "SmartGrid" mode.

2.1.1.2 Softkeys

Softkeys are virtual keys provided by the software. Thus, more functions can be provided than those that can be accessed directly via the function keys on the instrument. Softkeys are dynamic: depending on the selected function key, a different list of softkeys is displayed on the right side of the screen.

A list of softkeys for a certain function key is also called a menu. Softkeys can either perform a specific function or open a dialog box.

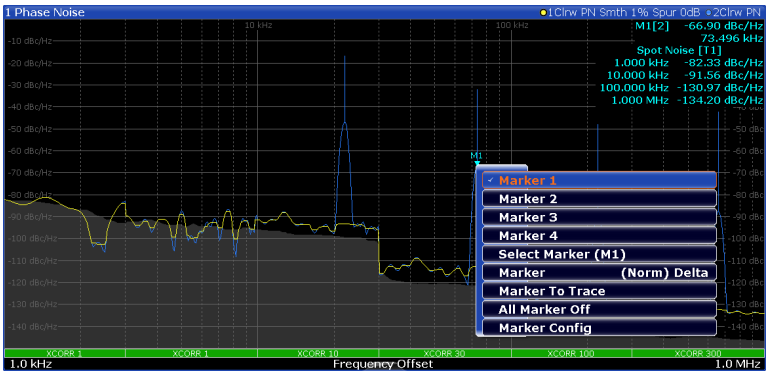
Recognizing the softkey status by color

Color	Meaning
orange	associated dialog box is open
blue	associated function is active; for toggle keys: currently active state
gray	instrument function is temporarily not available due to a specific setting or missing option

You can hide the softkey display, e.g. when using remote control, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items"). See the User Manual for details.

2.1.1.3 Context Menus

Several items in the diagram area have context menus (for example markers, traces or the channel bar). If you right-click on one of these items (or tap it for about 1 second), a menu is displayed which contains the same functions as the corresponding softkey. This is useful, for example, when the softkey display is hidden.



2.1.1.4 On-screen Keyboard

The on-screen keyboard is an additional means of interacting with the instrument without having to connect an external keyboard.

The on-screen keyboard display can be switched on and off as desired using the "On-Screen Keyboard" function key beneath the screen.

When you press this key, the display switches between the following options:

- Keyboard displayed at the top of the screen
- Keyboard displayed at the bottom of the screen
- No keyboard displayed

You can use the TAB key on the on-screen keyboard to move the focus from one field to another in dialog boxes.

2.1.2 Power Key

The Power key on the front panel turns the instrument on and off.

The color of the LED above the key shows its current state.
- Orange: instrument is in stand-by mode.
- Green: instrument is running.

For more information see chapter 1.1.5, "Switching the Instrument On and Off", on page 15.

2.1.3 System Control Keys

System control keys provide access to the basic instrument configuration.

Please refer to the User Manual for an extensive description of the system configuration functionality.

	Resets the instrument to its default configuration.
	Selects a particular measurement application or operating mode.
	Provides functionality to configure basic instrument characteristics, for example: • the LAN connection • the date and time • the display configuration • the reference frequency • firmware update and application installation • service functions
	Provides access to the on-screen keyboard.

	Turns full screen mode on and off.
	Selects a window in split screen mode or browses through active windows in full screen mode.

2.1.4 The Function Keys

Function keys provide access to the most common measurement settings and functions.

Please refer to the User Manual for an extensive description of the measurement settings and functions.

	Provides functionality to define frequency parameters, for example: • the measurement range • the signal frequency
	Provides functionality to configure the measurement range.
	Provides functionality to configure amplitude or level characteristics, for example: • the attenuation • the input impedance • the scale of the level axis • the preamplifier
	Provides functionality to automatically define various parameters like the level or frequency.
	Provides functionality to define various filter bandwidths.
	Provides functionality to configure the measurement, for example: • the measurement mode (single or continuous measurements) • the number of measurements
	Provides functionality to configure data acquisition and analyze measured data, for example: • the trace mode • the displayed result
	n/a
	Provides functionality to activate and position absolute and relative markers (markers and delta markers).
	Performs a peak search for active markers. If no marker is active, Marker 1 is activated and the peak search is performed for it.
	n/a

MKR→	Provides functionality to position and control markers, for example: • to configure the marker search • to configure the peak excursion
MEAS	Provides the measurement functions, for example: • the Phase Moise measurement
MEAS CONFIG	Provides functionality to configure the measurement.
LINES	Provides functionality to control display and limit lines.
INPUT / OUTPUT	Provides functionality to configure inputs and outputs.
RUN SINGLE	Starts a measurement in single measurement mode.
RUN CONT	Starts a measurement in continuous measurement mode.

2.1.5 The Keypad

The alphanumeric keys allow you to enter alphanumeric characters where necessary (for example in dialog boxes or input fields). The keypad containing the alphanumeric keys also provides keys that select a particular unit.

0 ... 9	Provide access to numbers and (special) characters.
.	Inserts a decimal point at the cursor position ("..").
–	Changes the sign of a numeric value or inserts a dash character ("-") in case of alphanumeric input.
Hz dB.. ... GHz -dBm	Selects a particular unit for a numeric value. The labels on and next to the key state the units it selects. Pressing one of the unit keys also completes the entry of a numeric value. Note that in case of level entries (dB, dBm etc.) or dimensionless values, all unit keys have the value "1" as multiplying factor and thus work like the ENTER key..

ESC	Provides the following functions: In dialog boxes: • Closes all kinds of dialog boxes if edit mode is not active. • Quits edit mode if it is active. • Selects the "Cancel" button when available. In "Edit" dialog boxes: • If data entry has been started, it retains the original value and closes the dialog box. • If data entry has not been started or has been completed, it closes the dialog box.
BACK-SPACE	Deletes the character to the left of the cursor (if an (alpha)numeric entry has been started already.
ENTER	Provides the following functions: • Completes the entry of input made with the alphanumeric keys (numeric or alphanumeric) and accepts the input. If you enter a numeric value that has a unit, the ENTER key works like the HZ/DB key. • Selects the default or focused element in dialog boxes.

2.1.6 Navigation Control

Navigation control consists of a rotary knob and cursor keys. These keys allow you to navigate within the display or within dialog boxes.

In addition to the rotary knob and the cursor keys, the navigation control also provides undo / redo functionality.

Rotary knob

The rotary knob allows you to do several things:

- It increases or decreases any kind of numeric value. In most cases, the rotary knob changes numeric values with a fixed step size.
  Turning it to the right corresponds to an increase, turning it to the left to a decrease of a numeric value.
- It works like a cursor key in dialog boxes or lists (for example dropdown menus). In that case you can navigate to one of the items with the rotary knob. If the dialog box covers more than one screen page, it also scrolls through the dialog box.
  Turning it to the right corresponds to a downward movement. Moving it to the left to an upward movement.
- It moves around markers and other graphical elements on the screen. In most cases, the step size is fix.
- Pressing the rotary knob has the same effect as pressing the ENTER key as it confirms an entry or selection.

Cursor keys

The cursor keys allow you to do several things:

- The up and down keys increase or decrease any kind of numeric value if an input field is active.
  The cursor keys change numeric values with a fixed step size.

- The cursor keys navigate through dialog boxes or lists (for example dropdown menus).
- The left and right keys move the cursor in an input field in the corresponding direction.
- The up and down keys move markers around.
  The step size is fix.
- The cursor keys allow you to navigate to a cell in a table.
- The cursor keys move a scroll bar (vertical or horizontal) in dialog boxes that have one.

Undo and redo functionality

UNDO	Reverts the software to an older state by erasing the last change you have applied. The undo function is useful, for example, if you are performing a measurement with several markers and a limit line and accidentally select a different measurement. In this case, a lot of settings would be lost. However, if you press UNDO immediately afterwards, the previous status is retrieved.
REDO	Reverses an undo action or repeats the most recently performed action.

The UNDO function is not available after a PRESET or "RECALL" operation. When these functions are used, the history of previous actions is deleted.

2.1.7 RF Input (50 Ω)

The RF Input allows you to connect a device under test (or DUT) to the R&S FSWP, usually via cable and an appropriate connector (for example a male N connector).

The supported frequency range depends on the R&S FSWP model you have. Refer to the datasheet for details.

The RF Input also serves as an attenuator in case you are measuring signal with high levels. The supported attenuation range depends on the R&S FSWP model you have. Refer to the datasheet for details..

NOTICE

Risk of instrument damage

Do not overload the RF input. For maximum allowed values, see the data sheet.

When measuring unknown signals, always apply attenuation to protect the input mixer. Otherwise, the input mixer may be damaged or destroyed.

For AC coupling, a DC input voltage of 50 V must never be exceeded. For DC coupling, DC voltage must not be applied at the input. In both cases, noncompliance will destroy the input mixers.

2.1.8 Signal Source Output

The Signal Source Output allows you to generate a signal that can be fed into the DUT or other external accessories like frequency dividers or amplifiers. You can connect the DUT or accessories with a cable that has a male N connector.

NOTICE

Risk of damage to the R&S FSWP

The maximum supported reverse power is 30 dBm. Make sure that this value is not exceeded to avoid damage to the R&S FSWP.

The maximum DC output voltage is 0 V.

For details on configuring the signal source output and generating a signal, see the User Manual.

2.1.9 USB Ports

The three USB ports on the front panel (type A) allow you to connect devices like keyboards, mouses or memory sticks.

The R&S FSWP provides additional USB ports (including one type B port) on the rear panel.

All USB ports support standard 2.0.

2.1.10 Power Sensors

The female Lemosa connector allows you to connect power sensors of the R&S NRP-Zxy family to the R&S FSWP.

For an extensive list of supported power sensors, refer to the data sheet.

For details on configuring and using power sensors, see the User Manual.

2.1.11 Probe Power Connector (3 Pins)

The Probe Power connector allows you to supply external equipment with power (for example probes or transducers).

The three-pinned probe power connector supports supply voltages from +15 V to -12.6 V and ground. The maximum permissible current is 150 mA. This probe power connector is suitable, for example, for high-impedance probes.

2.1.12 Noise Source Control

The female BNC connector labeled "Noise Source" allows you to connect and control an external noise source, and supplies the required supply voltage.

You can use a noise source, for example, to measure the noise figure and gain of amplifiers and frequency converting devices.

Conventional noise sources require a voltage of +28 V in order to be switched on and 0 V to be switched off. The output supports a maximum load of 100 mA.

2.1.13 Trigger Input and Output

The female BNC connector labeled "Trigger Input / Output" allows you to receive an external trigger signal or send a trigger signal to another device.

When you are using the connector as a trigger input, you can apply voltages in the range from 0.5 V to 3.5 V (the default value is 1.4 V). The typical input impedance is 10 kΩ.

When you are using the connector as a trigger output, the TTL compatible signal is transmitted (0 V / 5 V).

Note that you can find another connector for trigger input and output on the rear panel.

For more information about controlling and configuring trigger input and output, refer to the User Manual.

2.1.14 DC Power Supply

The female BNC connectors labeled "V_{Tune}", "V_{Aux}" and "V_{Supply}" allow you to supply external devices, for example a DUT or an external reference oscillator, with the required voltage.

The V_{Supply} connector provides supply voltage from 0 V to +16 V, for example to provide voltage for an oscillator. The supported maximum current is 2000 mA.

The V_{Tune} connector provides tuning voltage from -10 V to +28 V. The supported maximum current is 20 mA.

The V_{Aux} connector provides DC voltage from -10 V to +10 V. The supported maximum current is 100 mA.

For more information about configuring the DC Power supply, refer to the User Manual.

2.2 The Rear Panel

The rear panel contains various connectors for various purposes.

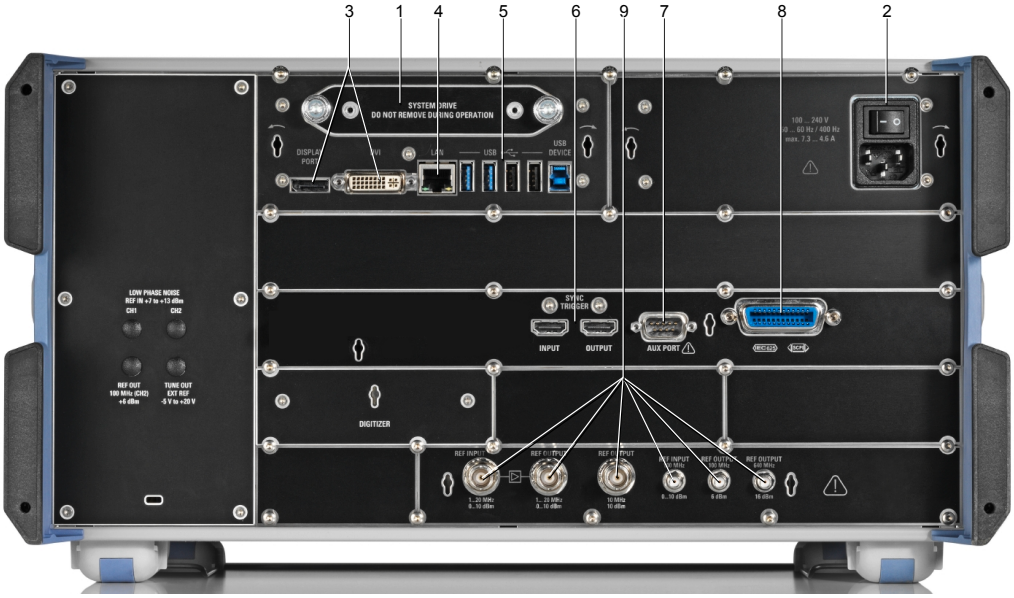


Fig. 2-2: Rear panel of the R&S FSWP

1 = Removable hard disk
2 = AC power connector and power switch
3 = DisplayPort and DVI
4 = LAN interface
5 = USB ports
6 = Sync trigger input and output
7 = AUX port
8 = GPIB interface
9 = Ref input and output

- Removable Hard Disk 40
- AC Power Connector and Main Power Switch 41
- DisplayPort and DVI 41
- LAN Connector 41
- USB Ports 41
- Sync Trigger Input and Output 41
- AUX Port 42
- GPIB Interface 42
- External Generator Control (Optional) 42
- OCXO (Optional) 42
- REF INPUT / REF OUTPUT 43

2.2.1 Removable Hard Disk

The removable hard disk is accessible from the rear of the instrument.

In addition to the operating system and the firmware, the R&S FSWP also stores measurement data on that disk. When you remove the hard disk, you can store it and the data on it somewhere secure.

2.2.2 AC Power Connector and Main Power Switch

The AC power supply and main power switch are located in a unit on the rear panel of the instrument.

The main power switch has the following states.

- Position "1": The instrument is supplied with power.
- Position "0": The instrument is disconnected from the power supply.

For details refer to chapter 1.1.4, "Connecting the AC Power", on page 15.

2.2.3 DisplayPort and DVI

You can connect an external monitor or other display device to the R&S FSWP. Another display device allows you to view the user interface on a bigger screen. Two different types of connectors are provided for this purpose:

- DisplayPort
- DVI (Digital Visual Interface)

For details see chapter 1.4, "Connecting an External Monitor", on page 22.

2.2.4 LAN Connector

The LAN interface allows you to connect the R&S FSWP to a local network for remote control, printouts or data transfer. The assignment of the RJ-45 connector supports twisted-pair category 5 UTP/STP cables in a star configuration (UTP stands for *unshielded twisted pair*, and STP for *shielded twisted pair*).

For details see chapter 11, "Network and Remote Operation", on page 212.

2.2.5 USB Ports

The four USB ports on the rear panel (type A) allow you to connect devices like keyboards, mouses or memory sticks.

The male USB connector (type B) allows you to connect the R&S FSWP to a computer and establish a remote control connection, for example.

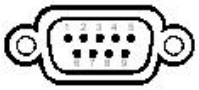
All USB connectors support standard 2.0.

2.2.6 Sync Trigger Input and Output

The "Sync Trigger Input / Output" connectors allow you to synchronize several devices (for example two R&S FSWPs) with respect to the trigger signal, but also the reference frequency. A 100 MHz signal can be output as a trigger or reference signal to another device, and an external trigger or reference signal can be received at the input connector by the R&S FSWP.

2.2.7 AUX Port

The 9 pole SUB-D male connector provides control signals for controlling external devices. The voltage levels are TTL compatible (max. 5 V).



Pin	Signal	Description
1	+5 V / max. 250 mA	Supply voltage for external circuits
2 to 7	I/O	Control lines for user ports (see User Manual)
8	GND	Ground
9	READY FOR TRIGGER	Signal indicating that the instrument is ready to receive a trigger signal (Low active = 0 V)

NOTICE

Short-circuit hazard

Always observe the designated pin assignment. A short-circuit may damage the instrument.

2.2.8 GPIB Interface

The GPIB interface is in compliance with IEEE488 and SCPI. A computer for remote control can be connected via this interface. To set up the connection, a shielded cable is recommended. For more details refer to "Setting Up Remote Control" in the User Manual.

2.2.9 External Generator Control (Optional)

The optional "External Generator Control" provides an additional GPIB interface and AUX port.

The GPIB connector can be used to connect an external generator to the R&S FSWP.

The AUX port is required for TTL synchronization, if supported by the generator. It is identical to the standard AUX port (see chapter 2.2.7, "AUX Port", on page 42).

For details on connecting an external generator see the "External Generator Control" section of the R&S FSWP User Manual.

2.2.10 OCXO (Optional)

This optional OCXO generates a 10 MHz reference signal with a very precise frequency. If installed, and if no external signal is used, this signal is used as an internal reference. It can also be used to synchronize other connected devices via the REF OUTPUT 10 MHz connector.

Warm-up time for OCXO

When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet). No warm-up time is required when starting from standby mode.

2.2.11 REF INPUT / REF OUTPUT

The REF INPUT connectors are used to provide an external reference signal to the R&S FSWP.

The REF OUTPUT connectors can be used to provide an external reference signal (or the optional OCXO reference signal) from the R&S FSWP to other devices that are connected to this instrument.

Various connectors are provided for different reference signals:

Connector	Reference signal	Usage
REF INPUT	1...20 MHz 0...10 dBm	To provide an external reference signal on the R&S FSWP.
REF OUTPUT	1...20 MHz 0...10 dBm	To provide the same external reference signal received by the REF INPUT 1...20 MHZ connector to another device, when available.
REF OUTPUT	10 MHz 10 dBm	To provide the internal reference signal from the R&S FSWP to another device continuously. Also used to provide OCXO reference signal to another device.
REF INPUT	100 MHz 0...10 dBm	To provide an external reference signal on the R&S FSWP.
REF OUTPUT	100 MHz 6 dBm	To provide a 100 MHz reference signal from the R&S FSWP to another device.
REF OUTPUT	640 MHz 16 dBm	To provide a 640 MHz reference signal from the R&S FSWP to another device.

SYNC TRIGGER

The SYNC TRIGGER connector can also be used to synchronize the reference frequency on several devices.

3 Trying Out the Instrument

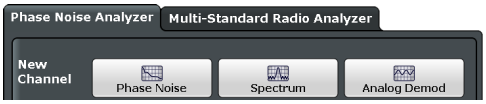
The following procedures provide an overview on how to use the features available in the Phase Noise measurement application.

Preparing the R&S FSWP

1. Connect the R&S FSWP to an electrical outlet as described in chapter 1.1.4, "Connecting the AC Power", on page 15.
2. Turn on the R&S FSWP as described in chapter 1.1.5, "Switching the Instrument On and Off", on page 15.

Selecting the Phase Noise application

1. Select the MODE key.
2. Select the "Phase Noise" item in the "Mode" dialog box.



There's more than one way to skin a cat

In most cases, the firmware of the R&S FSWP provides several ways to change measurement parameters. For example, the measurement range can be defined via the FREQ key, the "MEAS CONFIG" key or the "Overview dialog box."

All procedures in this chapter use the "Overview" dialog box as a starting point (when possible). You can reach this dialog via the "Overview" softkey displayed at the bottom of the softkey bar on the right side of the diagram area.

Performing a preset

Before configuring and starting a new measurement, it is always recommended to perform a preset and restore the default configuration of the instrument or the measurement application.

1. Select the PRESET key on the front panel to restore the default state of the R&S FSWP.
2. Enter the "Overview" dialog box and select the "Preset Channel" item to restore the default state of the selected measurement channel. All other measurement channels keep their custom configuration.

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- Controlling the Displayed Results 49
- Controlling the Measurement 54

3.1 Measuring Noise Characteristics

Measuring the noise characteristics of a DUT requires a simple measurement setup consisting of the R&S FSWP and a DUT.

- For additive noise measurements, the R&S FSWP must be equipped with the optional Signal Source hardware.
- For pulsed noise measurements, the R&S FSWP must be equipped with the optional Pulsed Phase Noise Measurement application.

3.1.1 Measuring the Phase Noise

Test setup

Connect the DUT via cable to the RF input of the R&S FSWP as shown in the illustration.

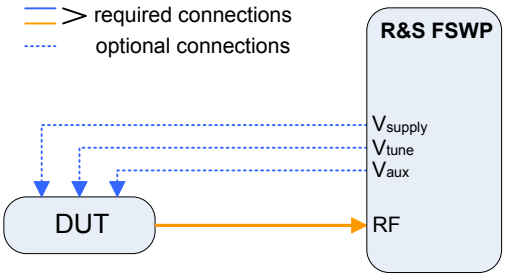


Fig. 3-1: Typical test setup for basic noise measurements

1. Perform a PRESET.

   The application automatically starts a continuous measurement.
   First, it searches for a carrier signal (see Searching for signals). When one has been found, it measures the noise characteristics of the DUT in the default measurement (or frequency offset) range.
   If no carrier could be found, a corresponding error message is displayed in the status bar below the diagram.

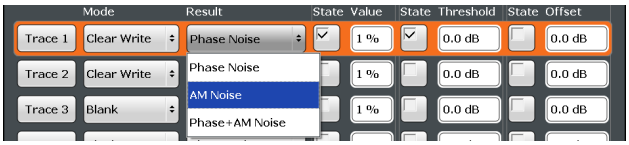
2. You can stop the measurement (to analyze the measurement data in detail) with the RUN SGL or RUN CONT key; RUN SGL performs one more measurement, then stops, RUN CONT stops immediately.
   By default, two traces are displayed: the first trace shows the smoothed data without spurs, the second trace the raw data including spurs.

Measuring the amplitude noise

The test setup is the same as shown above.

The default phase noise trace shows the phase noise characteristics of the DUT. In addition, you can also display the amplitude noise characteristics (or both together).

1. Enter the "Overview" dialog box and, from there, enter the "Analysis" dialog box.
2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.
3. For any trace, select "AM Noise" from the "Result" dropdown menu.



4. Start a new measurement to determine the AM noise of the DUT.
   (The "Phase + AM Noise" menu item displays the sum of phase and amplitude noise.)

   Tip: If you'd like to view both results separately at the same time, open two Phase Noise diagrams, one that shows the phase noise, the other showing the AM noise and perform a measurement.

In addition to the graphical representation of the phase noise characteristics, the application also provides several tables that show specific phase noise characteristics.

Measuring spurs

In addition to the graphical display of spurs in the diagram (long vertical lines), the application also features a spur table that contains a list of all detected spurs.

► Open the SmartGrid (⊞) and drag the "Spurious List" item from the evaluation bar into the display.

The list contains all detected spurs (including their characteristics) on all traces and all windows.
More information
A spur is detected if it is above a certain level threshold that you can define in the "Traces" dialog box.

Measuring spot noise

Spot noise is the phase noise or AM noise at a specific offset frequency (for example the phase noise at 500 kHz.

► Open the SmartGrid (⊞) and drag the "Spot Noise" item from the evaluation bar into the display.

The table contains a list of spot noise values for selected frequency offsets (in the default state, these are the decade edges) on each active trace.

More information

Tip: You can define custom spot noise frequencies in the "Spot Noise" tab of the "Noise Config" dialog box.

Measuring integrated noise

Integrated measurements show various noise characteristics, like the residual noise, integrated over a certain offset frequency range.

► Open the SmartGrid (▣) and drag the "Integrated Measurements" item from the evaluation bar into the display.

The table contains a list of integrated measurement results.

Integrated Measurements

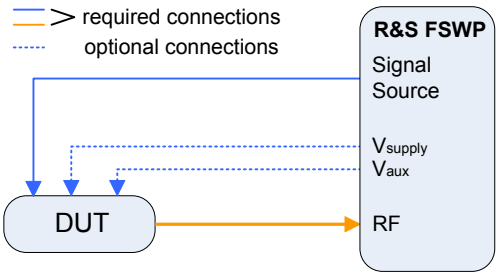
Tip: You can define custom integration ranges in the "Integration Ranges" tab of the "Noise Config" dialog box.

3.1.2 Measuring Additive Noise

Additive noise measurements require the Signal Source output that is available as an optional hardware component.

Test setup

Connect the DUT via cable to the RF input and the Signal Source output of the R&S FSWP as shown in the illustration.



1. Perform a PRESET.
2. Select the "Additive Noise" measurement via the MEAS key.
3. Configure the signal source output as described in "Generating a CW signal" on page 56.
4. Start the measurement (RUN SGL or RUN CONT).

   The application measures the additive noise on the output frequency of the signal source in the default measurement (or frequency offset) range.
5. You can stop the measurement (to analyze the measurement data in detail) with the RUN SGL or RUN CONT key; RUN SGL performs one more measurement, then stops, RUN CONT stops immediately.

By default, two traces are displayed: the first trace shows the smoothed data without spurs, the second trace the raw data including spurs.

Measuring the noise contribution of the R&S FSWP

If you perform a measurement, and would like to determine the contribution of the R&S FSWP to the overall noise, you can measure the intrinsic noise of the R&S FSWP and display it as a trace.

When you use this feature, leave the DUT connected as it is. The R&S FSWP uses a different signal during the while bypassing the DUT.

(Note that this feature only works for additive noise measurements.

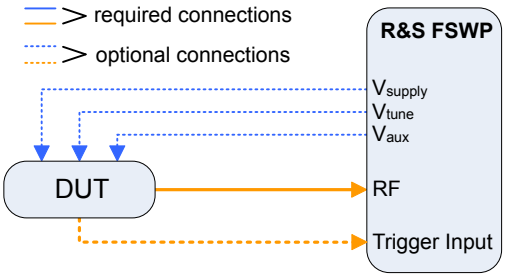
1. Enter the "Additive Noise" measurement.
2. Enter the "Overview" dialog box, and from there, enter the "Output" dialog box.
3. Select the vertical "Signal Source" tab.
4. Turn on the "DUT Bypass".
5. Perform a measurement.

   The application draws a trace that represents the noise characteristics of the R&S FSWP.
   When the measurement is done, and you have frozen the trace, you can continue with the actual measurement, and use (for example) trace mathematics to remove the noise contribution of the R&S FSWP from the results.

3.1.3 Measuring the Noise of a Pulse

Noise measurements on pulses are available with the optional Pulsed Phase Noise Measurements firmware application.

Test setup



1. Connect the DUT via cable to the RF input of the R&S FSWP as shown in the illustration.
2. Perform a PRESET.
3. Select the MEAS key and select the "Pulsed Phase Noise" measurement.

The application tries to detect a pulse in the signal you have applied, using two automatic mechanisms:
• search for the pulse frequency
• detection of the pulse characteristics
If successful, it configures a gate based on the pulse characteristics and starts the noise measurement of the pulse.
The results are displayed the same way as in the other measurements (two traces in the diagram and results for the integrated measurements).
If no frequency or pulse could be found, a corresponding error message is displayed in the status bar below the diagram.
If required, you can also define the frequency and the pulse characteristics manually.

3.1.4 Adding Another Measurement Channel

Measuring the noise characteristics in two different measurement channels allows you, for example, to capture and analyze two different data streams with different measurement configurations.

1. Select the MODE key.
2. Select the "Phase Noise" item in the "Mode" dialog box.

   The firmware adds a second instance of the Phase Noise application which is independent of the first one.

3.2 Controlling the Displayed Results

The Phase Noise application provides several tools to control the data displayed in the various result displays. Some tools have an effect on the graphical result displays, other on the numerical results and still others on both graphical and numerical (for example in ase the numerical results are based on the graphical results).

Smoothing the trace (trace averaging)

When you average the trace, the application measures the data several times and builds an average over all measurements when it is done. Averaging measurement data yields a smoother trace.

Trace averaging is applied to all traces.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.
2. Define the number of measurements to be performed in the "Sweep / Average Count" input field, for example "10".

3. Start the measurement.
   - In case of a single measurement, the application performs x measurements over the frequency range you have defined. An average count of "10", for example, would result in 10 measurements.
   - In case of continuous measurements, the application performs a moving average over the average count.

Smoothing the trace (cross-correlation)

When you apply cross-correlation operations, the application is able to determine the phase noise characteristics at a certain frequency offset more precisely.

You can improve cross-correlation performance with the corresponding hardware option.

More information

The number of cross-correlation operations applied in each half decade depends on a cross-correlation factor that you can define arbitrarily.

Cross-correlation operations are applied to all traces.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.
2. Define the cross-correlation factor as required in the "XCORR Factor" input field.

   The application calculates the number of cross-correlations for each half decade based on this factor. You can see the resulting operations in the table of the "Noise Config" dialog box.
   The number of operations calculated for each half decade targets a similar measurement time for all half decades, so that the measurement is done at roughly the same time in each half decade.
   You can also see the resulting number of operations in the green bar at the bottom of the diagram area.

Smoothing the trace (trace smoothing)

When you apply trace smoothing, the application takes the currently available data and smoothes the trace by applying mathematical operations.

More information

Trace smoothing is applied to each trace individually.

1. Enter the "Overview" dialog box, and from there, enter the "Analysis" dialog box.
2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.
3. For any trace, turn on "Smoothing" and define the amount by which the trace should be smoothed (in %) in the corresponding input field.

Trace smoothing is applied immediately after you have applied it to a trace.

Removing spurs from a trace

By default, the application already shows a trace without spurs (the yellow one). However, you can decide for each trace individually whether it shows spurs or not.

Spur removal is done after traces have been smoothed in any way.

1. Enter the "Overview" dialog box, and from there, enter the "Analysis" dialog box.
2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.
3. For any trace, remove or display spurs individually. You can also enter a threshold that defines a level from which a spur is recognized as a spur.

The application removes all signals that are above the threshold from the trace spur removal is applied to. Signals with levels below the threshold are not regarded as spurs and are still displayed.

More information

Note: Note that the threshold is always taken into account in the spur table, regardless of whether spur removal is on or off.

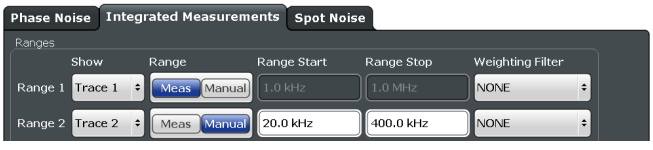
Defining integration ranges

For the integrated measurements (Residual AM, FM and PM and Jitter), you can define custom integration ranges.

By default, the integration range corresponds to the measurement range defined by the frequency offsets. Custom integration ranges can have any range you desire.

Integration is done after traces have been smoothed in any way.

1. Enter the "Overview" dialog box and, from there, enter the "Noise Config" dialog box.
2. Select the "Integrated Measurements" tab.



3. Select the a "Trace" whose data you would like to integrate from the "Show "drop-down menu.

   Tip: If you select a trace that is currently not displayed in the diagram, no integrated measurement results will be displayed for the corresponding range.

4. Select "Manual" integration ranges.
5. Define the frequency ranges ("Range Start" and "Range Stop") over which you would like to integrate.

   The application calculates the measurement results as defined. Result in the Integrated Measurements result table are adjusted accordingly (see "Measuring integrated noise" on page 47 for a description on how to view that table).

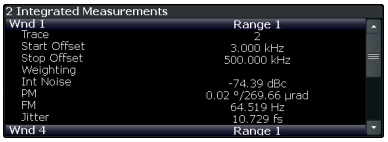


Fig. 3-2: Custom integration range results (frequency range from 3 kHz to 500 kHz, applied to trace 2)

Note that the integration ranges are displayed graphically in the Noise Spectrum diagram.

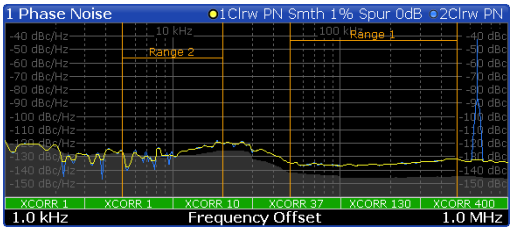


Fig. 3-3: Custom integration ranges are represented in the diagram as colored lines

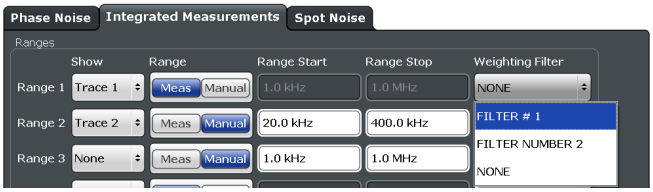
More information

Correcting integrated measurements

You can use so called weighting filters to compensate external effects that affect the phase noise in certain frequency ranges.

Weighting filters are applied before trace are smoothed and before integration is applied.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.
2. Select the "Integrated Measurements" tab.
3. Select a weighting filter from the corresponding dropdown menu.



The dropdown menu contains all filters currently available on the harddisk of the R&S FSWP.

When you apply the weighting filter, the results are automatically corrected by the filter characteristics.
If you do not have a filter yet, or want to change filter characteristics for an existing filter, design one or change one.
For more information see "Designing weighting filters" on page 109 and "Managing weighting filters" on page 109.

Controlling the cross-correlation gain indicator (grey area)

The grey trace, or cross-correlation gain indicator, indicates the ideal position of the measurement trace for the current number of cross-correlation operations. Thus, the position of this area depends on the number of cross-correlations that are currently applied in each half decade.

This in turn indicates that measurement traces that are close to the grey area (even if only in places) can be improved by increasing the cross-correlation operations. On the other hand, when the measurement trace lies above the grey area throughout (about 10 dB), it is not possible to improve the results any more.

See "Turning the display of the cross-correlation gain indicator on and off" on page 106 for a more detailed explanation.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.
2. Select the "Noise Config" tab.
3. Change the "XCORR Factor", run a single measurement, and see how the position of the grey area changes.

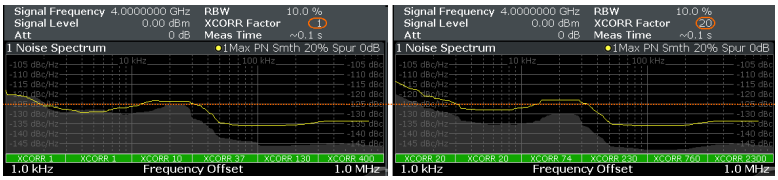


Fig. 3-4: Increasing XCORR operations changes shape of grey area

4. If required, you can turn this area on and off as required with the "XCORR Gain Indicator" feature.

Using trace mathematics

Trace mathematics may be useful for certain measurement scenarios, for example if you want to subtract the intrinsic noise of the R&S FSWP from the measurement result and thus determine the noise of the DUT only.

1. Perform a measurement to determine the noise contribution of the R&S FSWP.
2. Freeze the trace.
   a) Enter the "Overview" dialog box, and from there, enter the "Analysis" dialog box.
   b) Select the vertical and horizontal "Traces" tab.

c) For the recorded trace, select "Trace Mode: View".

3. Perform an additive noise measurement of the complete setup.
4. Enter the "Traces" dialog box again, and select the "Trace Math" tab.
5. Select the operation that subtracts the first recorded trace (intrinsic noise) from the measurement results.

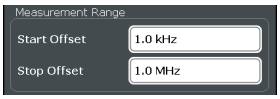
3.3 Controlling the Measurement

The Phase Noise application provides several tools that make the measurement process easier to handle or allow you to customize the measurement configuration according to your needs.

Defining the measurement range

The measurement range defines the carrier frequency offset over which the phase noise measurement takes place.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.
2. Select the "Noise Config" tab.
3. Define the measurement range with the "Start Offset" and "Stop Offset" properties.



The application adjusts the measurement range. You can see this change, for example, in the Noise diagram result display.
More information

Searching for signals

The application allows you to search for a carrier signal, instead of defining the carrier frequency manually.

1. Enter the "Overview" dialog box, and from there, enter the "Frequency" dialog box.
2. Turn on the "Auto Search" feature (it is on by default).
3. Define the frequency range in which the search should take place ("Start" and "Stop"). By default the search is done in the maximum frequency range supported by the hardware.
4. Define a "Threshold" for the search. Signals below the threshold are ignored during the search.

   When the application finds a signal with appropriate characteristics, it starts a phase noise measurement in the measurement range you have defined.

Defining a carrier frequency manually

When you already know the frequency of the carrier signal, you can define it manually and reduce the measurement time.

1. Enter the "Overview" dialog box, and from there, enter the "Frequency" dialog box.
2. Turn off the "Auto Search" feature.
3. Define the "Signal Frequency".

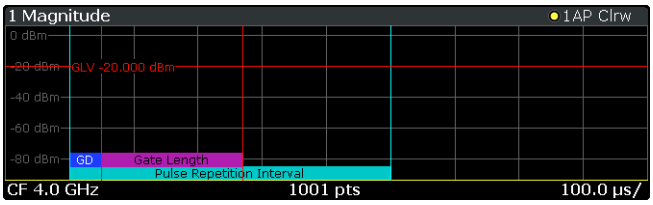
   The application performs the measurement on the defined frequency.

Configuring a gate for measurements on pulses

Noise measurements on pulses are available with the optional Pulsed Phase Noise Measurements firmware application.

1. Enter the Pulsed Phase Noise measurement.
2. Select the MEAS CONFIG key and enter the "Pulse" dialog box with the "Pulse Config" softkey.
3. In the "Pulse" dialog box, select "Manual" pulse detection.

   The input fields for the "Pulse Repetition Interval" and those for the "Gate Characteristics" become available.
4. Configure the gate as required.
   The shape of the gate is represented by various lines and bars in the "Preview" diagram that is part of the dialog box.



More information

Tip: You can turn off the gate, if one is not required for the measurement.
To do so, select "Gate Type: Off".

Zooming into the results

The zoom tool is useful if you want to see parts of the results in more detail.

1. Select the "Zoom" icon in the toolbar ( ).
2. In the diagram, select the area you want to zoom in to (while doing this, the area is marked by a dotted line).
3. You can return to the full display any time with the "Unzoom" icon in the toolbar ( ).

Supplying DUTs with current or voltage

Some measurement setups or DUTs require you to supply them with either voltage or current.

The R&S FSWP can provide both, when you set it up that way.

1. Enter the "Overview" dialog box and, from there, enter the "Output" dialog box.
2. Select the "DC Config" tab.

   There you have the following options:

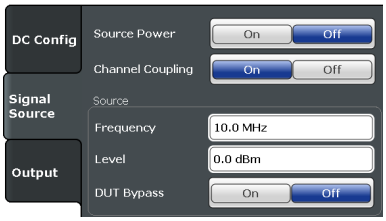
   - Turn each of the three DC connectors on or off.
   - Define the supplied voltage (or current in case of the first connector).
   - Define limits for the connectors. When you define limits, the supplied voltage will not go below or above these.
     More information
3. Turn on the output of voltage or current with the "DC Power" feature.

   Tip: You can turn the output on and off easily with the "DC On / Off" button in the toolbar. The "DC Config" button provides access to a softkey menu that lets you define the signal characteristics without entering a dialog box.

Generating a CW signal

Available only for additive noise measurements and with the optional Signal Source hardware component.

1. Enter the Additive Noise measurement.
2. Enter the "Overview" dialog box, and from there, enter the "Output" dialog box.
3. Select the "Signal Source" tab.
4. Define the frequency and level of the CW signal in the corresponding input fields.



5. Turn the signal source on with the "Source Power" feature.

   Tip: You can turn the signal source on and off effectively with the "RF On/Off" button in the toolbar. The "RF Config" button provides access to a softkey menu that lets you change the voltages for each connector without entering a dialog box.

Labeling traces

Labeling traces with a short keyword is a good way to distinguish traces and see immediately what the trace actually represents.

1. Enter the "Overview" dialog box and, from there, enter the "Analysis" dialog box.

2. Select the vertical "Traces" tab and the horizontal "Trace Label" tab.
3. Turn on the trace label for a certain trace and define a string of text as a label.

   The application adds a label to the trace. The color of the label is the same as the trace color.

   Tip: You can move trace labels around via drag and drop.

Exporting measurement data

Exporting measurement data to a .dat file allows you to archive that data in external programs like a spreadsheet.

1. Enter the "Overview" dialog box and, from there, enter the "Analysis" dialog box.
2. Select the vertical "Traces" tab and the horizontal "Trace / Data Export" tab.
3. Select the data types as required (trace data only or together with numerical results and / or measurement settings).
4. Select the "Export to ASCII File" button and select the destination where you want to save that data.
5. View the .dat file that has been created with your preferred program.

4 Operating the Instrument

The following topics provide an overview on how to work with the R&S FSWP. They describe what kind of information is displayed in the diagram area, how to operate the R&S FSWP via the front panel keys and other interaction methods, and how to use the Online Help.

- Understanding the Display Information....58
- Accessing the Functionality....66
- Changing the Focus....66
- Entering Data....66
- Displaying Results....68
- Remote Control....76

4.1 Understanding the Display Information

The following figure shows a measurement diagram in the Spectrum application. All different information areas are labeled. They are explained in more detail in the following sections.

1 = Channel bar for firmware and measurement settings
2 = Window title bar with diagram-specific (trace) information
3 = Diagram area with marker information
4 = Instrument status bar with, for example, error messages and progress bar.

Hiding elements in the display

You can hide some of the elements in the display, for example the status bar or channel bar, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items").

For details see the R&S FSWP User Manual.

- Channel Bar 59
- Window Title Bar 60
- Marker Information 61
- Spot Noise Information 62
- Measurement Progress Information 63
- Frequency Information in Diagram Footer 63
- Instrument and Status Information 64
- Error Information 64

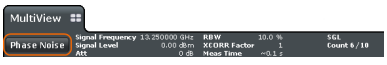
4.1.1 Channel Bar

Using the R&S FSWP you can handle several different measurement tasks (channels) at the same time (although they can only be performed asynchronously). For each channel, a separate tab is displayed on the screen. In order to switch from one channel display to another, simply select the corresponding tab.

Alternatively, if many tabs are displayed, select the tab selection list icon at the right end of the channel bar and select the channel you want to switch to from the list.

MultiView tab

An additional tab labelled "MultiView" provides an overview of all active channels at a glance. In the "MultiView" tab, each individual window contains its own channel bar with an additional button. Tap this button to switch to the corresponding channel display quickly.



Icons in the channel bar

The star icon ( ) on the tab label indicates that the displayed trace no longer matches the current instrument settings. This may be the case, for example, if a trace is frozen and the instrument settings are changed. As soon as a new measurement is performed, the icon disappears.

The exclamation mark ("!" or) icon indicates that an error or warning is available for that measurement channel. This is particularly useful if the MultiView tab is displayed.

The icon indicates the currently active channel during an automatic measurement sequence (**Sequencer** functionality).

Beneath the channel name, information on channel-specific settings for the measurement are displayed in the **channel bar**. Channel information varies depending on the active application.

In addition to the channel-specific settings, the channel bar above the diagram also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values. This information is displayed only when applicable for the current measurement.

The following table contains all labels that might be displayed in the Spectrum and Receiver applications.

Table 4-1: Channel settings displayed in the channel bar

Label	Information
Signal Frequency	Current carrier frequency of the applied signal.
Signal Level	Currently level measured on the carrier frequency.
Att	Current RF attenuation.
RBW	Current Resolution bandwidth (RBW). The RBW is a function of the start offset frequency of each half decade included in the measurement.
XCORR Factor	Current cross-correlation factor. The cross-correlation factor defines the number of cross-correlations are done in each half decade included in the measurement.
Meas Time (estimated)	Current estimated measurement time. The measurement time depends, among other things, on the offset frequency, the resolution bandwidth or the number of averages / cross-correlations that you have defined.
SGL	Current number of measurements performed in a single sweep. Only displayed if you are in single sweep measurement mode.
Count	The current signal count for measurement tasks that involve a specific number of subsequent sweeps.
Meas	Currently selected measurement (Phase Noise, Additive Phase Noise etc.).

Icons for individual settings

A bullet next to the setting indicates that user-defined settings are used, not automatic settings. A green bullet indicates this setting is valid and the measurement is correct. A red bullet indicates an invalid setting that does not provide useful results.

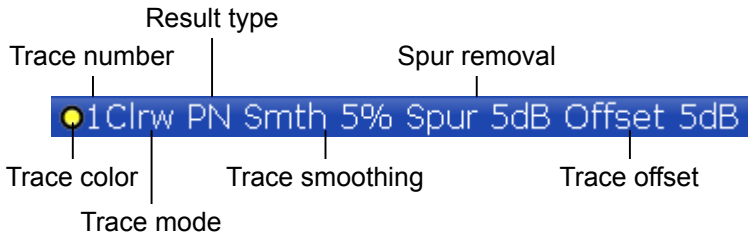
4.1.2 Window Title Bar

Each channel in the R&S FSWP display may contain several windows. Each window can display either a graph or a table as a result of the channel measurement. Which type of result evaluation is displayed in which window is defined in the display configu-

ration (see chapter 4.5, "Displaying Results", on page 68). The window's title bar indicates which type of evaluation is displayed.

Trace Information in Window Title Bar

Information on the displayed traces is indicated in the window title bar.



Trace color	Color of trace display in diagram
Trace number	Number of the trace (1 to 6)
Trace Mode	Abbreviation of the trace mode: • Clrw Clear Write trace • Max Max Hold trace • Min Min Hold trace • Avg Average trace • View Frozen trace • WrH Write Hold trace
Result type	Type of result the trace represents. • PN • AM • PN + AM
Trace smoothing	Trace smoothing characteristics. Only displayed if trace smoothing has been turned on for a trace.
Spur removal	Spur removal characteristics. Only displayed if spur removal has been turned on for a trace.
Trace offset	Trace offset characteristics. Only displayed if an offset has been defined for a trace.

4.1.3 Marker Information

Marker information is provided either in the diagram grid or in separate marker tables, depending on the configuration.

Marker information in diagram grid

Within the diagram, the x-axis and y-axis positions of the last 2 markers or delta markers that were set are displayed, if available, as well as their index. The value in the square brackets after the index indicates the trace to which the marker is assigned.

(Example: M2[1] defines marker 2 on trace 1.) For more than 2 markers, a separate marker table is displayed beneath the diagram by default.

Marker information in marker table

In addition to the marker information displayed within the diagram grid, separate marker tables may be added to the display. These tables provide the following information for all active markers:

Table 4-2: Regular marker table

Label	Information
Wnd	Window type the marker is positioned in. (Only if there is more than one window containing a phase noise diagram.)
Type	Marker type: N (normal), D (delta), T (temporary, internal)
Ref	Reference (for delta markers)
Trc	Trace to which the marker is assigned
X-value	x-value of the marker
Y-value	y-value of the marker

4.1.4 Spot Noise Information

Spot noise information in diagram grid

The diagram contains information about all spot noise positions [T<x>]. Spot noise information is made up out of the position of the spot noise measurement on the x-axis and the y-axis. The value in the square brackets after the index indicates the trace to which the spot noise calculation is assigned (Example: [T1] indicates trace 1). Note that you can also display spot noise information in a separate table.

Spot noise information in spot noise table

The R&S FSWP also provides a numerical result table for the spot noise measurement. The spot noise table has to be added deliberately. Note that the spot noise table only contains information when the calculation of spot noise has been turned on.

Table 4-3: Spot noise information result table

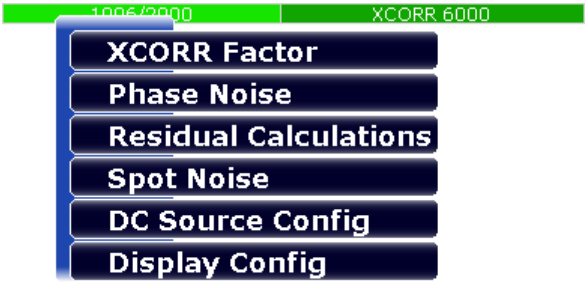
Label	Information
Wnd	Measurement window that the spot noise has been calculated for. (Only if there is more than one window containing a phase noise diagram.)
Offset	Offset frequency or spot noise position on the x-axis of the Phase Noise diagram.
Noise [T<x>]	Measured noise on the spot noise position for each active trace.

4.1.5 Measurement Progress Information

The Phase Noise result display shows the progress of the measurement in a series of green bars at the bottom of the diagram area. For each half decade in the measurement, the R&S FSWP adds a bar that spans the frequency range of the corresponding half decade.

The bar has several features.

- Measurement times less than 1 s
  The numbers within the green bar indicate the number of cross-correlation operations applied to the corresponding half decade.
- Measurement times greater than 1 s
  The numbers within the green bar show the progress of the cross-correlation operations in the half decade the application currently works on.
  The first number is the current, the second number the total count of cross-correlations for that half decade. The bars of half decades in which a measurement is still running has a lighter tone of green than bars of half decades in which the measurement has already finished (see image below).
- A double-click on the bar opens the "Noise Config" dialog box to define the cross-correlation factor for that half decade.
- A right-click on the bar opens a context menu.



The context menu provides easy access to various parameters to set up the measurement.

4.1.6 Frequency Information in Diagram Footer

Graphical result displays contain information in the diagram footer. The information (beneath the diagram) depends on the result display.

The contents depend on the application and the result display.

Label	Information
Start offset	Start offset frequency
Stop offset	Stop offset frequency

4.1.7 Instrument and Status Information

Global instrument settings and functions (such as LXI configuration mode), the instrument status and any irregularities are indicated in the status bar beneath the diagram.

In the MultiView tab the status bar always displays the information for the currently selected measurement.

The following information is displayed:

Instrument status

	The state of the DC Power features. • white label = DC Power has been turned off • green label = DC Power has been turned on and is within the defined limits • red label = DC Power has been turned on and violates the defined limits
	The R&S FSWP is configured for operation with an external reference.
	The status of an LXI connection (green label = connection established, red label = connection not established).

Progress

The status of the current operation is displayed in the status bar.

In the MultiView tab, the progress bar indicates the status of the currently selected measurement, not the measurement currently being performed by a Sequencer, for example.

Date and time

The date and time settings of the instrument are displayed in the status bar.

Error messages and warnings

If errors or irregularities are detected, a keyword and an error message, if available, are displayed in the status bar.

4.1.8 Error Information

If errors or irregularities are detected, a keyword and an error message, if available, are displayed in the status bar.

Depending on the type of message, the status message is indicated in varying colors.

Table 4-4: Status bar information - color coding

Color	Type	Description
red	Error	An error occurred at the start or during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be started or completed correctly.
orange	Warning	An irregular situation occurred during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
gray	Information	Information on the status of individual processing steps.
no color	No errors	No message displayed - normal operation.
green	Measurement successful	Some applications visualize that the measurement was successfull by showing a messsage.

If any error information is available for a measurement channel, an exclamation mark is displayed next to the channel name (). This is particularly useful when the MultiView tab is displayed, as the status bar in the MultiView tab always displays the information for the currently selected measurement only.

Furthermore, a status bit is set in the `STATus:QUEStionable:EXTended:INFO` register for the application concerned (see "STATus:QUEStionable:EXTended:INFO Register" on page 240). Messages of a specific type can be queried using the `SYST:ERR:EXT?` command, see `SYSTem:ERRor:EXTended?` on page 416.

Table 4-5: Keywords in the status bar

Message	Meaning
IF OVLD	Overload of the IF signal path in the A/D converter or in the digital IF. Increase attenuation or remove the signal from the RF input.
LOUNL	Error in the instrument's frequency processing hardware was detected.
NO REF	Instrument was set to an external reference but no signal was detected on the reference input.
OVEN	The optional OCXO reference frequency has not yet reached its operating temperature. The message usually disappears a few minutes after power has been switched on.
UNCAL	One of the following conditions applies: • Correction data has been switched off. • No correction values are available, for example after a firmware update. • Record the correction data by performing a self alignment
WRONG_FW	The firmware version is out-of-date and does not support the currently installed hardware. Until the firmware version is updated, this error message is displayed and self-alignment fails. (For details refer to the R&S FSWP User Manual).

4.2 Accessing the Functionality

All tasks necessary to operate the instrument can be performed using this user interface. Apart from instrument specific keys, all other keys that correspond to an external keyboard (e.g. arrow keys, ENTER key) operate conform to Microsoft.

For most tasks, there are at least 2 alternative methods to perform them:

- Using the touchscreen
- Using other elements provided by the front panel, e.g. the keypad, rotary knob, or arrow and position keys.

The measurement and instrument functions and settings can be accessed by selecting one of the following elements:

- System and function keys on the front panel of the instrument
- Softkeys on the touchscreen
- Context menus for specific elements on the touchscreen
- Icons on the tool bar in the touchscreen
- Displayed setting on the touchscreen

4.3 Changing the Focus

Any selected function is always performed on the currently focused element in the display, e.g. a dialog field, diagram, or table row. Which element is focused is indicated by a blue frame (diagram, window, table) or is otherwise highlighted (softkey, marker etc.). Moving the focus is most easily done by tapping on the element on the touchscreen. Alternatively, use the "Tab" key on the on-screen keyboard or the rotary knob to move the focus from one element to the next on the display.

To move the focus between any displayed diagrams or tables in a window, press the "Change focus" key on the front panel. The focus moves from the diagram to the first table to the next table etc. and then back to the diagram, within the same window.

In fullscreen mode, where a single window is displayed in full size on the screen, this key switches the focus (and the display) from one active window to the next.

4.4 Entering Data

Data can be entered in dialog boxes using one of the following methods:

- Using the touchscreen, via the online keyboard
- Using other elements provided by the front panel, e.g. the keypad, rotary knob, or navigation keys
  The rotary knob acts like the ENTER key when it is pressed.
- Using a connected external keyboard

Particularities in Windows dialog boxes

In some cases, e.g. if you want to install a printer, original Windows dialog boxes are used. In these dialog boxes, the rotary knob and function keys do not work. Use the touchscreen instead.

4.4.1 Entering Numeric Parameters

If a field requires numeric input, the keypad provides only numbers.

1. Enter the parameter value using the keypad, or change the currently used parameter value by using the rotary knob (small steps) or the UP or DOWN keys (large steps).
2. After entering the numeric value via keypad, press the corresponding unit key. The unit is added to the entry.
3. If the parameter does not require a unit, confirm the entered value by pressing the ENTER key or any of the unit keys.
   The editing line is highlighted in order to confirm the entry.

4.4.2 Entering Alphanumeric Parameters

If a field requires alphanumeric input, you can use the on-screen keyboard to enter numbers and (special) characters (see chapter 2.1.1.4, "On-screen Keyboard", on page 32).

Alternatively, you can use the keypad. Every alphanumeric key represents several characters and one number. The decimal point key (.) represents special characters, and the sign key (-) toggles between capital and small letters. For the assignment refer to table 4-6.

Entering numbers and (special) characters via the keypad

1. Press the key once to enter the first possible value.
2. All characters available via this key are displayed.
3. To choose another value provided by this key, press the key again, until your desired value is displayed.
4. With every key stroke the next possible value of this key is displayed. If all possible values have been displayed, the series starts with the first value again. For information on the series refer to table 4-6.
5. To change from capital to small letters and vice versa, press the sign key (-).
6. When you have chosen the desired value, wait for 2 seconds (to use the same key again), or start the next entry by pressing another key.

Entering a blank

► Press the "Space" bar, or press the "0" key and wait 2 seconds.

Correcting an entry:

1. Using the arrow keys, move the cursor to the right of the entry you want to delete.
2. Press the BACKSPACE key.
   The entry to the left of the cursor is deleted.
3. Enter your correction.

Completing the entry

► Press the ENTER key or the rotary knob.

Aborting the entry

► Press the ESC key.
The dialog box is closed without changing the settings.

Table 4-6: Keys for alphanumeric parameters

Key name (upper inscription)	Series of (special) characters and number provided
7	7 µ Ω ° € ¥ $ ¢
8	A B C 8 Ä ÆÅ Ç
9	D E F 9 É
4	G H I 4
5	J K L 5
6	M N O 6 Ñ Ö
1	P Q R S 1
2	T U V 2 Ü
3	W X Y Z 3
0	<blank> 0 – @ + / \ < > = % &
.	. * : _ , ; " ' ? ( ) #
–	<toggles between capital and small letters>

4.5 Displaying Results

The R&S FSWP provides several instrument applications for different analysis tasks and different types of signals, for example the Phase Noise application, the optional

Spectrum application or the optional I/Q Analyzer. For each application, a new measurement channel is created and displayed in a separate tab on the screen.

The results of a measurement channel can be evaluated in many different ways, both graphically and numerically. For each evaluation method the results are displayed in a separate window in the tab.

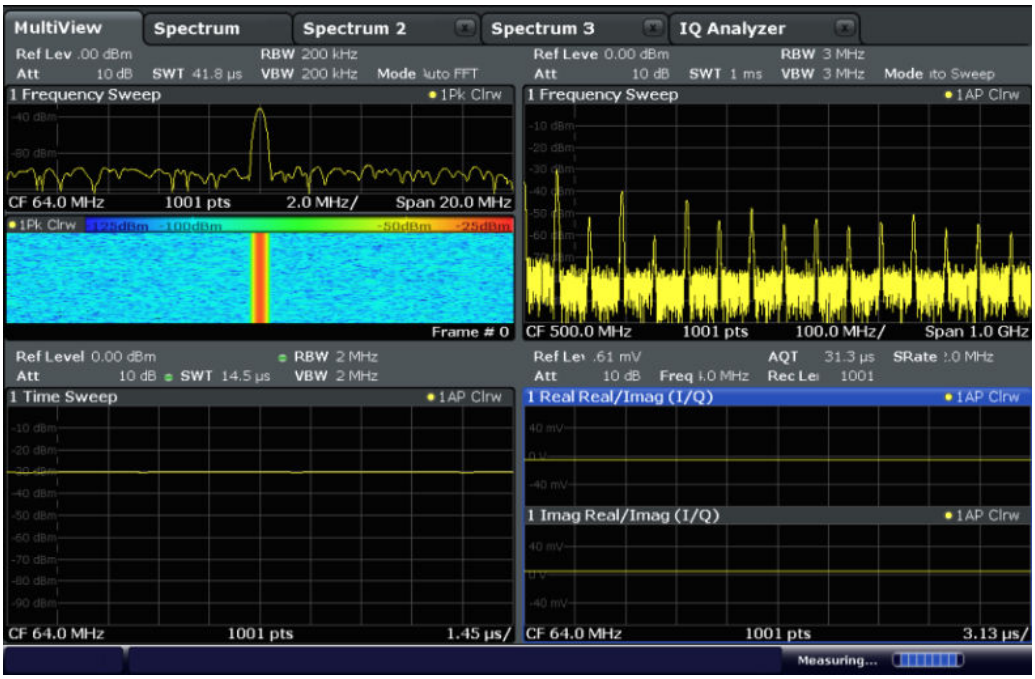
The R&S FSWP allows you to configure the display to suit your specific requirements and optimize analysis.

4.5.1 Activating and Deactivating Channels

When you activate an application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application. Whenever you switch channels, the corresponding measurement settings are restored. Each channel is displayed in a separate tab on the screen.

An additional tab ("MultiView") provides an overview of all currently active channels at once.

Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.



To start a new channel

1. Select the MODE key.
2. In the "Mode" dialog box, select the required application on the "New Channel" tab. A new tab is displayed for the new channel.

Remote command:

INSTrument:CREate[:NEW] on page 285/ INSTrument:CREate:DUPLicate on page 285

To change the application in an active channel

1. Select the tab of the channel you want to change.
2. Select the MODE key.
3. In the "Mode" dialog box, select the new application to be displayed on the "Replace Current Channel" tab.
   The selected application is displayed in the current channel.

Remote command:

INSTrument:CREate:REPLace on page 286

To close a measurement channel

►

Select the "Close" icon on the tab of the measurement channel.

The tab is closed, any running measurements are aborted, and all results for that channel are deleted.

Remote command:

INSTrument:DELete on page 286

4.5.2 Laying out the Result Display with the SmartGrid

Measurement results can be evaluated in many different ways, for example graphically, as summary tables, statistical evaluations etc. Each type of evaluation is displayed in a separate window in the channel tab. Up to 16 individual windows can be displayed per measurement channel (i.e. per tab). To arrange the diagrams and tables on the screen, the Rohde & Schwarz SmartGrid function helps you find the target position simply and quickly.

Principally, the layout of the windows on the screen is based on an underlying grid, the SmartGrid. However, the SmartGrid is dynamic and flexible, allowing for many different layout possibilities. The SmartGrid functionality provides the following basic features:

- Windows can be arranged in columns or in rows, or in a combination of both.
- Windows can be arranged in up to four rows and four columns.
- Windows are moved simply by dragging them to a new position on the screen, possibly changing the layout of the other windows, as well.
- All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar. If the evaluation bar contains more icons

than can be displayed at once on the screen, it can be scrolled vertically. The same evaluation method can be displayed in multiple windows simultaneously.

- New windows are added by dragging an evaluation icon from the evaluation bar to the screen. The position of each new window depends on where you drop the evaluation icon in relation to the existing windows.
- All display configuration actions are only possible in SmartGrid mode. When SmartGrid mode is activated, the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

- Background Information: The SmartGrid Principle....71
- How to Activate SmartGrid Mode....72
- How to Add a New Result Window....73
- How to Close a Result Window....73
- How to Arrange the Result Windows....74

4.5.2.1 Background Information: The SmartGrid Principle

SmartGrid display

During any positioning action, the underlying SmartGrid is displayed. Different colors and frames indicate the possible new positions. The position in the SmartGrid where you drop the window determines its position on the screen.

Fig. 4-1: Moving a window in SmartGrid mode

The brown area indicates the possible "drop area" for the window, i.e. the area in which the window can be placed. A blue area indicates the (approximate) layout of the window as it would be if the icon were dropped at the current position. The frames indicate the possible destinations of the new window with respect to the existing windows:

above/below, right/left or replacement (as illustrated in figure 4-2). If an existing window would be replaced, the drop area is highlighted in a darker color shade.

Positioning the window

The screen can be divided into up to four rows. Each row can be split into up to four columns, where each row can have a different number of columns. However, rows always span the entire width of the screen and may not be interrupted by a column. A single row is available as the drop area for the window in the SmartGrid. The row can be split into columns, or a new row can be inserted above or below the existing row (if the maximum of 4 has not yet been reached).

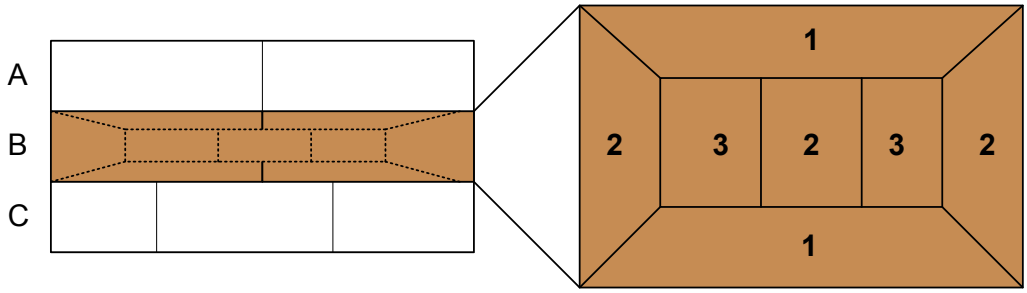


Fig. 4-2: SmartGrid window positions

1 = Insert row above or below the existing row
2 = Create a new column in the existing row
3 = Replace a window in the existing row

SmartGrid functions

Once the evaluation icon has been dropped, icons in each window provide delete and move functions.

The "Move" icon allows you to move the position of the window, possibly changing the size and position of the other displayed windows.

The "Delete" icon allows you to close the window, enlarging the display of the remaining windows.

4.5.2.2 How to Activate SmartGrid Mode

All display configuration actions are only possible in SmartGrid mode. In SmartGrid mode the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

► To activate SmartGrid mode, do one of the following:

-

  Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the configuration "Overview".

- Select the "Display Config" softkey from the MEAS CONFIG menu.

The SmartGrid functions and the evaluation bar are displayed.

To close the SmartGrid mode and restore the previous softkey menu select the "Close" icon in the right-hand corner of the toolbar, or press any key.

4.5.2.3 How to Add a New Result Window

Each type of evaluation is displayed in a separate window. Up to 16 individual windows can be displayed per measurement channel (i.e. per tab).

1. Activate SmartGrid mode.

   All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar.

2. Select the icon for the required evaluation method from the evaluation bar.
   If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. Touch the evaluation bar between the icons and move it up or down until the required icon appears.

3. Drag the required icon from the evaluation bar to the SmartGrid, which is displayed in the diagram area, and drop it at the required position. (See chapter 4.5.2.5, "How to Arrange the Result Windows", on page 74 for more information on positioning the window).

Remote command:

`LAYout:ADD[:WINDow]?` on page 333 / `LAYout:WINDow<n>:ADD?` on page 337

4.5.2.4 How to Close a Result Window

► To close a window, activate SmartGrid mode and select the "Delete" icon for the window.

Remote command:

`LAYout:REMove[:WINDow]` on page 335 / `LAYout:WINDow<n>:REMove` on page 338

4.5.2.5 How to Arrange the Result Windows

1. Select an icon from the evaluation bar or the "Move" icon for an existing evaluation window.

2. Drag the evaluation over the SmartGrid.
   A blue area shows where the window will be placed.
3. Move the window until a suitable area is indicated in blue.
4. Drop the window in the target area.

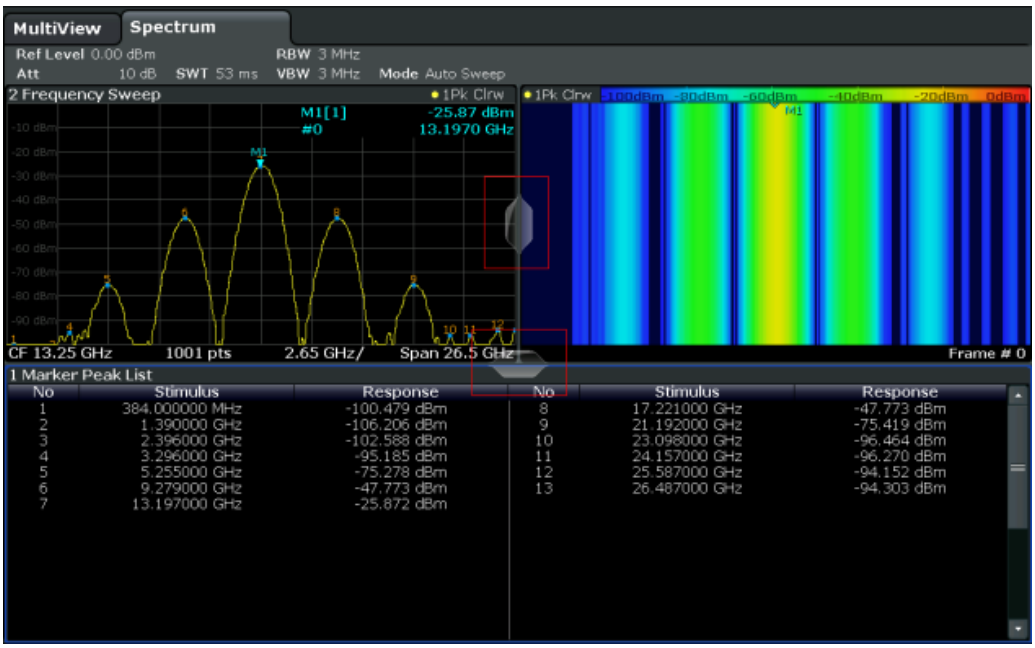
   The windows are rearranged to the selected layout, and "Delete" and "Move" icons are displayed in each window.
5. To close a window, select the corresponding "Delete" icon.

Remote command:

`LAYout:REPLace[:WINDow]` on page 335 / `LAYout:WINDow<n>:REPLace` on page 338

4.5.3 Changing the Size of Windows

Each channel tab may contain several windows to evaluate the measurement results using different methods. A "splitter" allows you to change the size of neighboring windows.



The splitters are not available in SmartGrid mode.

► To change the size of two neighboring windows, drag the splitter between the windows in either direction.

4.5.4 Switching Between a Split and Maximized Window Display

To get an overview of the results, displaying several windows at the same time may be helpful. However, the individual windows may become rather small. In this case it is useful to maximize an individual window to the entire screen temporarily in order to analyze the results in more detail.

To switch between a split and a maximized display without having to close and re-open windows, press the SPLIT/MAXIMIZE key on the front panel. In maximized display, the currently focused window is maximized. In split display, all active windows are displayed.

4.5.5 Changing the Display

The display can be optimized for your individual needs. The following display functions are available and are described in detail in chapter 10.3, "Display Settings", on page 198 and chapter 8.1, "Result Display Configuration", on page 120.

- Displaying a simulation of the entire front panel of the instrument on the screen ("Front Panel")
- Displaying the main function hardkeys in a separate window on the screen ("Mini Front Panel")
- Hiding or showing various screen elements
- Selecting a display theme and colors
- Changing the display update rate
- Activating or deactivating the touch-sensitivity of the screen
- Zooming into the diagram

4.6 Remote Control

In addition to working with the R&S FSWP interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC. Various methods for remote control are supported:

- Connecting the instrument to a (LAN) network (see chapter 1.5, "Setting Up a Network (LAN) Connection", on page 23)
- Using the LXI browser interface in a LAN network
- Using the Windows Remote Desktop application in a LAN network
- Connecting a PC via the GPIB interface

How to configure the remote control interfaces is described in the User Manual.

The R&S FSWP is delivered with *IECWIN* installed, the auxiliary remote control tool provided free of charge by R&S.

For details on the IECWIN tool, see the "Network and Remote Control" chapter of the R&S FSWP User Manual.

4.6.1 Using the LXI Browser Interface in a LAN

LAN eXtensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB. The LXI browser interface allows for easy configuration of the LAN and remote control of the R&S FSWP without additional installation requirements.

Restrictions

Only user accounts with administrator rights can make use of the LXI functionality. For details see chapter 1.2.3, "Login", on page 18.

4.6.2 Remote Desktop Connection

Remote Desktop is a Windows application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer, and Remote Desktop provides access to all of the applications, files, and network resources of the instrument. Thus, remote operation of the instrument is possible.

With Windows 7, Remote Desktop Client is part of the operating system. For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on.

4.6.3 Connecting a PC via the GPIB Interface

A GPIB interface is integrated on the rear panel of the instrument. You can set the GPIB address and the ID response string. The GPIB language is set as SCPI by default but can be changed to emulate other instruments. By connecting a PC to the R&S FSWP via the GPIB connection you can send remote commands to control and operate the instrument.

5 Applications

The R&S FSWP is a dedicated Phase Noise Analyzer whose main feature is the Phase Noise measurement application.

When equipped accordingly (with optional hardware or software), it is able to provide several additional applications for different analysis tasks (for example the Spectrum application).

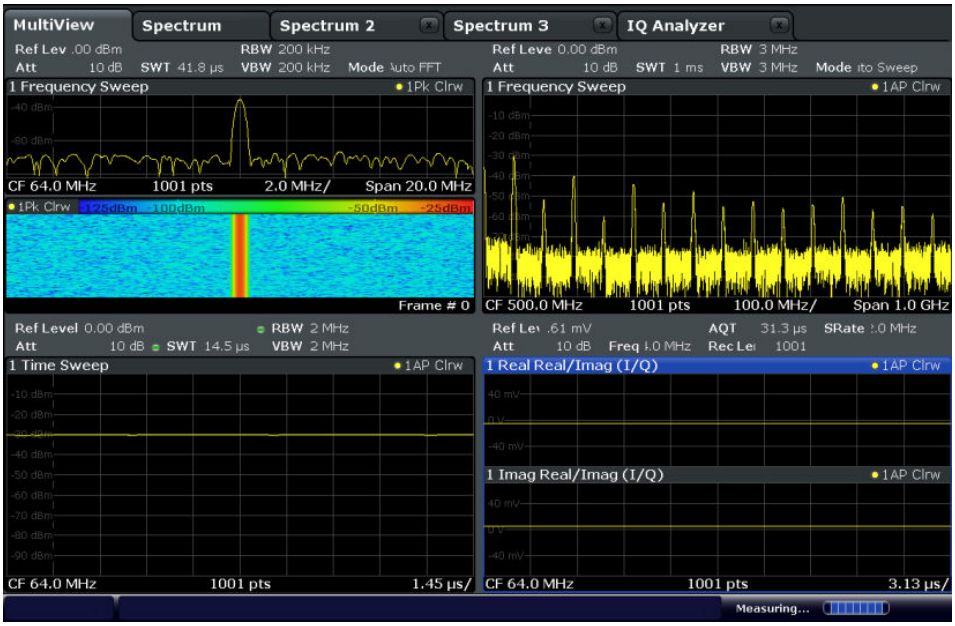
When you activate an application, the R&S FSWP creates a new measurement channel which in turn determines the measurement settings for that application. You can use the same application with different measurement settings by creating several channels for the same application. Each channel is represented by a separate tab on the screen.

Note that the number of channels may be limited by the available memory of the R&S FSWP.

- R&S MultiView 78
- Available Applications 79
- Starting an Application 80
- Running a Sequence of Measurements 81

5.1 R&S MultiView

Each application is displayed in a separate tab. An additional tab ("MultiView") provides an overview of all currently active channels at a glance. In the "MultiView" tab, each individual window contains its own channel bar with an additional button. Select this button to switch to the corresponding channel display quickly.



Remote command:

DISPlay:FORMat on page 332

5.2 Available Applications

Depending on its outfit, the R&S FSWP provides one or more applications for specific measurement tasks.

Phase Noise....79
Spectrum....79
Analog Demodulation....79
I/Q Analyzer....80
Noise Figure....80
Vector Signal Analysis (VSA)....80

Phase Noise
The Phase Noise application provides measurement functions to perform phase noise measurements.

This application is used in the initial configuration.

For details see chapter 6, "Measurements and Result Displays", on page 86.

Remote command:
INST:SEL PNO, see INSTrument[:SELect] on page 287

Spectrum
The Spectrum application is an optional application that is available with R&S FSWP-B1.

In the Spectrum application the provided functions correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the RF input signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal.

For details see the Spectrum Analyzer User Manual.

Remote command:
INST:SEL SAN, see INSTrument[:SELect] on page 287

Analog Demodulation
The Analog Demodulation application requires an instrument equipped with the Spectrum Analyzer hardware (R&S FSWP-B1) and the Analog Demodulation option (R&S FSWP-K7).

The Analog Demodulation application provides measurement functions for demodulating AM, FM, or PM signals.

For details see the Analog Demodulation User Manual.

Remote command:
INST:SEL ADEM, see INSTrument[:SELect] on page 287

I/Q Analyzer
The I/Q Analyzer application requires an instrument equipped with the Spectrum Analyzer hardware component (R&S FSWP-B1).

The I/Q Analyzer application provides measurement and display functions for I/Q data.

For details see the I/Q Analyzer User Manual.

Remote command:
`INST:SEL IQ`, see `INSTrument[:SELect]` on page 287

Noise Figure
The Noise Figure application requires an instrument equipped with the Spectrum Analyzer hardware (R&S FSWP-B1) and the Noise Figure Measurements option (R&S FSWP-K30).

For details see the R&S FSWP-K30 User Manual.

Remote command:
`INST:SEL NOISE`, see `INSTrument[:SELect]` on page 287

Vector Signal Analysis (VSA)
The VSA application requires an instrument equipped with the Spectrum Analyzer hardware (R&S FSWP-B1) and the Vector Signal Analysis option (R&S FSWP-K70). This application provides measurement and evaluations for Vector Signal Analysis.

For details see the R&S FSWP-K70 User Manual.

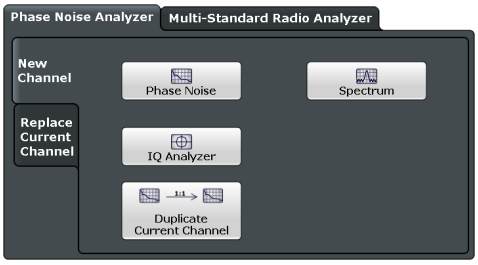
Remote command:
`INST:SEL DDEM`, see `INSTrument[:SELect]` on page 287

5.3 Starting an Application

The default application that is running when you start the R&S FSWP is the Phase Noise application.

Access to application selection

► MODE



To select an application, select the corresponding button.

To deactivate a channel, simply close the corresponding tab.

The remote commands required to perform these tasks are described in chapter 12.4, "Selecting the Operating Mode and Application", on page 284.

The measurement channels are labeled with their default name. If that name already exists, a sequential number is added.

In remote control, the name of the measurement channel can be changed. For details and an overview of default names see `INSTrument:LIST?`.

New Channel....81
Replace Current Channel....81
Duplicate Current Channel....81

New Channel
The applications selected on this tab are started in a new channel, i.e. a new tab in the display.

Remote command:
`INSTrument:CREate[:NEW]` on page 285
`INSTrument[:SELect]` on page 287

Replace Current Channel
The applications selected on this tab are started in the currently displayed channel, replacing the current application.

Remote command:
`INSTrument:CREate:REPLace` on page 286

Duplicate Current Channel
The currently active channel can be duplicated, i.e. a new measurement channel of the same type and with the identical measurement settings is started. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

Remote command:
`INSTrument:CREate:DUPLicate` on page 285

5.4 Running a Sequence of Measurements

Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

- The Sequencer Concept 82
- Sequencer Settings 84
- How to Set Up the Sequencer 84

5.4.1 The Sequencer Concept

The instrument can only be in one specific channel at any time. Thus, only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided, which changes the application of the instrument as required. If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. For each individual measurement, the sweep count is considered. Thus, each measurement may consist of several sweeps. The currently active measurement is indicated by a ✿ symbol in the tab label. The result displays of the individual channels are updated in the tabs as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

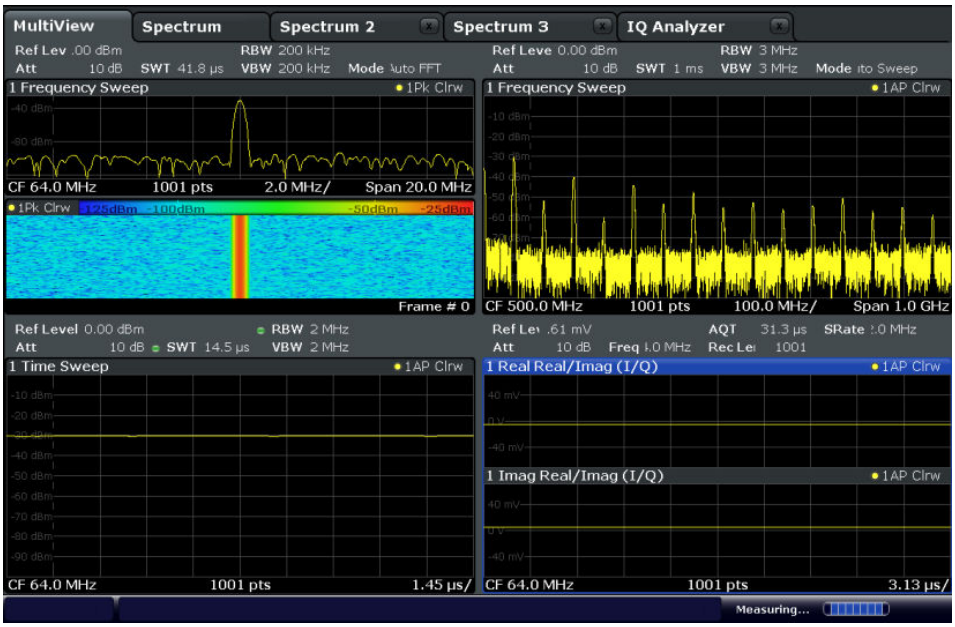
Sequencer modes

Three different Sequencer modes are available:

- **Single Sequence**
  Similar to single sweep mode; each measurement is performed once, until all measurements in all active channels have been performed.
- **Continuous Sequence**
  Similar to continuous sweep mode; the measurements in each active channel are performed one after the other, repeatedly, in the same order, until sequential operation is stopped. This is the default Sequencer mode.
- **Channel-defined Sequence**
  First, a single sequence is performed. Then, only channels in continuous sweep mode are repeated continuously.

Example: Sequencer procedure

Assume the following active channel definition:



Tab name	application	Sweep mode	Sweep count
Spectrum	Spectrum	Cont. Sweep	5
Spectrum 2	Spectrum	Single Sweep	6
Spectrum 3	Spectrum	Cont. Sweep	2
IQ Analyzer	IQ Analyzer	Single Sweep	7

For **single Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer

For **continuous Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

...

For **channel-defined Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

5x Spectrum, 2 x Spectrum 3,

5x Spectrum, 2 x Spectrum 3,

...

RUN SINGLE/RUN CONT and Single Sweep/Sweep Continuous keys

While the Sequencer is active, the RUN SINGLE and RUN CONT keys control the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode, while RUN CONT starts the Sequencer in continuous mode.

The "Single Sweep" and "Continuous Sweep" *softkeys* control the sweep mode for the currently selected channel only; the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer. A channel in continuous sweep mode is swept repeatedly.

5.4.2 Sequencer Settings

The "Sequencer" menu is available from the toolbar.

Sequencer State 84
Sequencer Mode 84

Sequencer State
Activates or deactivates the Sequencer. If activated, sequential operation according to the selected Sequencer mode is started immediately.

Remote command:
`SYSTem:SEQuencer` on page 290
`INITiate<n>:SEQuencer:IMMediate` on page 288
`INITiate<n>:SEQuencer:ABORt` on page 288

Sequencer Mode
Defines how often which measurements are performed. The currently selected mode softkey is highlighted blue. During an active Sequencer process, the selected mode softkey is highlighted orange.

"Single Sequence"
Each measurement is performed once, until all measurements in all active channels have been performed.

"Continuous Sequence"
The measurements in each active channel are performed one after the other, repeatedly, in the same order, until sequential operation is stopped.
This is the default Sequencer mode.

"Channel-defined Sequence"
First, a single sequence is performed. Then, only channels in continuous sweep mode are repeated.

Remote command:
`INITiate<n>:SEQuencer:MODE` on page 289

5.4.3 How to Set Up the Sequencer

In order to perform the configured measurements consecutively, a Sequencer function is provided.

1. Configure a channel for each measurement configuration as required, including the sweep mode.

2. In the toolbar, select the "Sequencer" icon.

   The "Sequencer" menu is displayed.

3. Toggle the "Sequencer" softkey to "On".

   A continuous sequence is started immediately.

4. To change the Sequencer mode and start a new sequence immediately, select the corresponding mode softkey, or press the RUN SINGLE or RUN CONT key.

   The measurements configured in the currently active channels are performed one after the other in the order of the tabs until the Sequencer is stopped.
   The result displays in the individual channels are updated as the measurements are performed.

To stop the Sequencer

► To stop the Sequencer temporarily, press the highlighted RUN SINGLE or RUN CONT key (not for a channel-defined sequence). To continue the Sequencer, press the key again.
To stop the Sequencer permanently, select the "Sequencer" icon in the toolbar and toggle the "Sequencer" softkey to "Off".

6 Measurements and Result Displays

The noise performance of a DUT is usually described by various effects and signal characteristics that can be measured by the R&S FSWP.

The R&S FSWP provides several measurements, each of which analyzes different noise characteristics for different types of signal.

All measurements support several result displays, each of which shows different aspects of the noise characteristics of the measured signal.

- Basics on Phase Noise Measurements 86
- Performing Measurements 87
- Selecting Measurements 89
- Result Displays 90

6.1 Basics on Phase Noise Measurements

- Residual Effects 86

6.1.1 Residual Effects

Residual noise effects are modulation products that originate directly from the phase noise. It is possible deduct them mathematically from the phase noise of a DUT.

The application calculates three residual noise effects. All calculations are based on an integration of the phase noise over a particular offset frequency range.

Residual PM

The residual phase modulation is the contribution of the phase noise to the output of a PM demodulator. It is evaluated over the frequency range you have defined.

$$\text{Residual PM} = \sqrt{2 \cdot \int_{f_{start}}^{f_{stop}} L(f_m) df_m} \; [rad]$$

with $L(f)$ = single sideband phase noise [dBc/Hz]

Residual FM

The residual frequency modulation is the contribution of the phase noise to the output of an FM demodulator. It is evaluated over the frequency range you have defined.

$$\text{Residual FM} = \sqrt{2 \cdot \int_{f_{start}}^{f_{stop}} f_m^2 L(f_m) df_m \ [Hz]}$$

with $L(f_m)$ = single sideband phase noise [dBc/Hz]

f_m = frequency [Hz]

Jitter

The jitter is the RMS temporal fluctuation of a carrier with the given phase noise evaluated over a given frequency range of interest.

$$\text{Jitter[s]} = \frac{\text{ResidualPM [rad]}}{2\pi \cdot f_0}$$

with f_0 = Carrier frequency

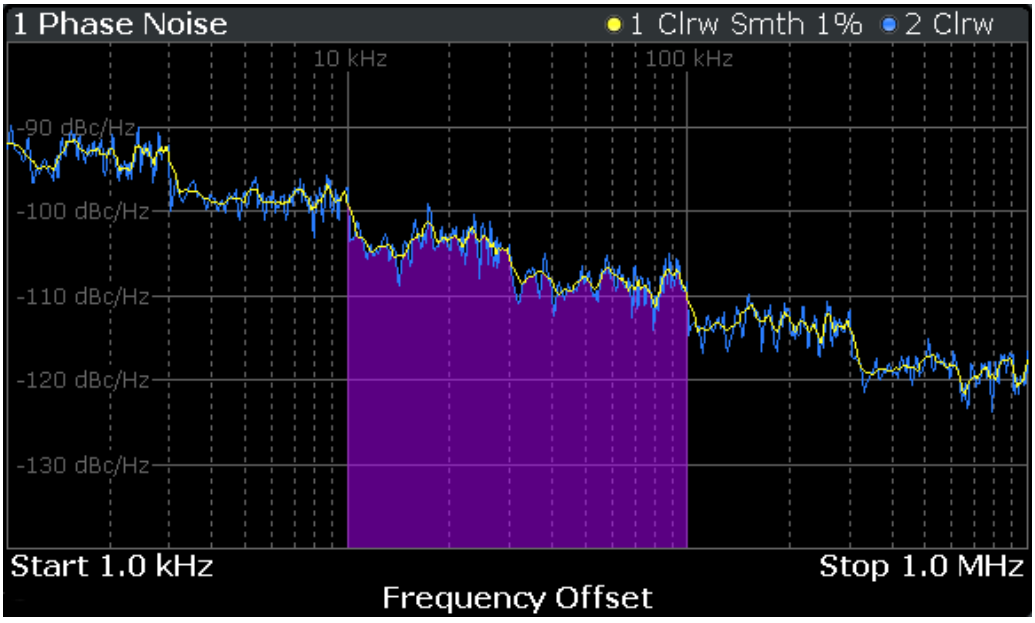


Fig. 6-1: Residual noise based on an integration between 10 kHz and 100 kHz offset

6.2 Performing Measurements

How to perform a single measurement

1. Configure the measurement range to be measured ("Frequency" dialog box, see chapter 7.4, "Frequency", on page 102).
2. Configure the number of measurements to be performed in a single measurement ("Sweep Config" dialog box, see "Sweep / Average Count" on page 106).

3. Define how the results are evaluated for display ("Trace" dialog box, see chapter 8.3, "Trace Configuration", on page 129).
4. To start the measurement, select one of the following:
   - RUN SINGLE key
   - "Single Sweep" softkey in the "Sweep" menu

   The defined number of sweeps are performed, then the measurement is stopped. While the measurement is running, the RUN SINGLE key is highlighted. To abort the measurement, press the RUN SINGLE key again. The key is no longer highlighted. The results are not deleted until a new measurement is started.
5. To repeat the same number of measurements without deleting the last trace, select the "Continue Single Sweep" softkey in the "Sweep" menu.

To start continuous measurements

1. If you want to average the trace or search for a maximum over more (or less) than 10 measurements, configure the "Average/Sweep Count" ("Sweep Config" dialog box, see "Sweep / Average Count" on page 106).
2. To start the measurement, select one of the following:
   - RUN CONT key
   - "Continuous Sweep" softkey in the "Sweep" menu

   After each sweep is completed, a new one is started automatically. While the measurement is running, the RUN CONT key is highlighted. To stop the measurement, press the RUN CONT key again. The key is no longer highlighted. The results are not deleted until a new measurement is started.

Single Sweep/ RUN SINGLE 88
Continuous Sweep/RUN CONT 89
Continue Single Sweep 89

Single Sweep/ RUN SINGLE
Initiates a single measurement. The measurement is finished after all frequencies in the frequency list have been measured. If necessary, the application automatically determines the reference level before starting the actual measurement.

While the measurement is running, the "Single Sweep" softkey and the RUN SINGLE key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer.
Furthermore, the RUN SINGLE key controls the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode.

If the Sequencer is off, only the evaluation for the currently displayed measurement channel is updated.

For details on the Sequencer, see chapter 5.4.1, "The Sequencer Concept", on page 82.

Remote command:
INITiate<n>[:IMMediate] on page 298

Continuous Sweep/RUN CONT
Initiates a measurement and repeats it continuously until stopped. If necessary, the application automatically determines the reference level before starting the actual measurement.

While the measurement is running, the "Continuous Sweep" softkey and the RUN CONT key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again. The results are not deleted until a new measurement is started.

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly.
Furthermore, the RUN CONT key controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

For details on the Sequencer, see chapter 5.4.1, "The Sequencer Concept", on page 82.

Remote command:
INITiate<n>:CONTinuous on page 298

Continue Single Sweep
Repeats the number of measurements defined by the "Sweep Count", without deleting the trace of the last measurement.

While the measurement is running, the "Continue Single Sweep" softkey and the RUN SINGLE key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Remote command:
INITiate<n>:CONMeas on page 297

6.3 Selecting Measurements

The R&S FSWP provides a number of noise measurements, each determining different noise aspects of different types of signal.

To select the measurement

The measurement can be selected via the "Measurement" dialog box.

► To display the "Measurement" dialog box, select the MEAS key.

Phase Noise Measurement....90
Additive Noise measurements (optional)....90
Pulsed Phase Noise measurements (optional)....90

Phase Noise Measurement
Provides tools to measure the noise characteristics of a continuous wave signal.

This measurement measures the combined noise characteristics of the components in the test setup.

Remote command:
`CONFigure:PNOise:MEASurement` on page 293

Additive Noise measurements (optional)
Provides tools to measure the additive noise characteristics of a continuous wave signal.

The optional Signal Source that is necessary for this measurement allows you to measure the noise characteristics of individual components in the test setup.

Remote command:
`CONFigure:PNOise:MEASurement` on page 293

Pulsed Phase Noise measurements (optional)
Provides tools to measure the noise characteristics of pulses.

The optional Pulsed Phase Noise measurement application measures the combined noise characteristics of the components in the test setup.

Remote command:
`CONFigure:PNOise:MEASurement` on page 293

6.4 Result Displays

Result displays show different aspects of the measurement results in numerical or graphical form.

Depending on the measurement, one or more result displays are supported.

Phase Noise, Additive Noise and Pulsed Phase Noise measurements:

- "Noise Diagram" on page 91
- "Integrated Measurements" on page 91
- "Spurious List" on page 92
- "Spot Noise" on page 93
- "Marker Table" on page 93

Noise Diagram....91
Integrated Measurements....91
Spurious List....92
Spot Noise....93
Marker Table....93

Noise Diagram

The "Noise Diagram" shows the power level of the noise over a variable frequency offset from the carrier frequency.

The unit of both axes in the diagram is fix. The x-axis always shows the offset frequencies in relation to the carrier frequency on a logarithmic scale in Hz. It always has a logarithmic scale to make sure of a equal representation of offsets near and far away from the carrier. The range of offsets that the x-axis shows is variable and depends on the measurement range you have defined and the scope of the x-axis that you have set.

The y-axis always shows the noise power level contained in a 1 Hz bandwidth in relation to the level of the carrier. The unit for this information is dBc/Hz and is also fix.

The scale of the y-axis is variable. Usually it is best to use the automatic scaling that the application provides, because it makes sure that the whole trace is always visible. You can, however, also customize the range, the minimum and the maximum values on the y-axis by changing the y-axis scale.

The measurement results are displayed as traces in the diagram area. Up to six active traces at any time are possible. Each of those may have a different setup and thus show different aspects of the measurement results.

In the default state, the application shows two traces. A yellow one and a blue one. Both result from the same measurement data, but have been evaluated differently. On the first trace, smoothing has been applied, the second one shows the raw data.

The diagram also contains a grey area in its default state. This trace represents the cross-correlation gain indicator.

Remote command:
`TRACe<n>[:DATA]?` on page 299

Integrated Measurements

The "Integrated Measurements" display summarizes the residual effects results in a table.

The table consists of up to four rows with each row representing a different integration interval. Each row basically contains the same information, which depends on the residual effects configuration.

Result	Description
Wnd	Shows the number of the measurement window the integration is done in (usually "1", unless you have several Noise Diagrams open at the same time).
Range	Shows the index of the integration range (1 to 4).
Trace	Shows the number of the trace the integration is applied to.
Start / Stop Offset	Shows the start and stop offset of the integration interval.
Weighting	Shows the name of the weighting filter, if you have applied one.

Result	Description
Int Noise	Shows the Integrated Noise. The integral is calculated over the frequency range defined by the Start and Stop Offset values.
PM	Shows the Residual PM result in degrees and rad. (Only available for Phase Noise traces.)
FM	Shows the Residual FM results in Hz. (Only available for Phase Noise traces.)
Jitter	Shows the Jitter in seconds. (Only available for Phase Noise traces.)

Remote command:
Int. PHN: `FETCh<n>[:RANGe<r>]:PNOise<t>:IPN?` on page 295
FM: `FETCh<n>[:RANGe<r>]:PNOise<t>:RFM?` on page 296
PM: `FETCh<n>[:RANGe<r>]:PNOise<t>:RPM?` on page 297
Jitter: `FETCh<n>[:RANGe<r>]:PNOise<t>:RMS?` on page 296

Spurious List

Spurs are peak levels at one or more offset frequencies and are caused mostly by interfering signals. The application shows the location of all detected spurs in a table.

More information

Note that only signals above a certain threshold are regarded as spurs (see Removing spurs). This threshold is also considered in the Spurious List if spur removal has been turned off for a trace.

The table consists of a variable number of rows. For each detected spur, the table shows several results.

Wnd	Shows the number of the measurement window the spur is in (usually "1", unless you have several Noise Diagrams open at the same time).
Trace	Shows the trace the spur is on.
Spur	Shows the spur number. Spurs are sorted by their frequency, beginning with the spur with the lowest frequency.
Offset	Shows the position (offset frequency) of the spur.

Power	Shows the power level of the spur in dBc.
Jitter	Shows the jitter value of the spur in s. In addition to the jitter for each spur, the result display also shows the Discrete Jitter and the Random Jitter at the end of the table. • The Discrete Jitter is the RMS value of all individual jitter values. • The Random Jitter is the difference of the overall jitter (as shown in the Integrated Measurements result display) and the Discrete Jitter. The result is an RMS value: RandomJitter2 = Jitter2 - DiscreteJitter2

Remote command:
`FETCh<n>:PNOise<t>:SPURs?` on page 294
`FETCh<n>:PNOise<t>:SPURs:JITTer?` on page 295
`FETCh<n>:PNOise<t>:SPURs:DISCrete?` on page 294
`FETCh<n>:PNOise<t>:SPURs:RANDom?` on page 295

Spot Noise

Spot noise is the noise at a particular frequency offset (or spot) that is part of the measurement range. It is thus like a fixed marker.

The unit of spot noise results is dBc/Hz. The application shows the results in a table.

The table consists of a variable number of 10_x frequencies (depending on the measurement range), and a maximum of six user frequencies, with each row containing the spot noise information for a particular frequency offset.

The spot noise information is made up out of several values.

Offset Frequency	Shows the offset frequency the spot noise is evaluated for. You may add any offset that is part of the measurement range. The number in brackets (T<x>) indicates the trace the result refers to.
Noise[T<x>]	Shows the noise for the corresponding offset frequency. The number in brackets (T<x>) indicates the trace the result refers to.

Remote command:
Querying spot noise results on 10_x offset frequencies:
`CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:X?` on page 326
`CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:Y?` on page 326
Querying custom spot noise results:
`CALCulate<n>:SNOise<m>[:TRACe<t>]:Y?` on page 328

Marker Table

Displays a table with the current marker values for the active markers.

This table may be displayed automatically if configured accordingly.

Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Ref	Shows the reference marker a delta marker refers to.
Trace	Shows the trace the marker is positioned on.
X- / Y-Value	Shows the marker coordinates (usually frequency and level).

Tip: To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 333
Results:
`CALCulate<n>:MARKer<m>:X` on page 352
`CALCulate<n>:MARKer<m>:Y?` on page 359

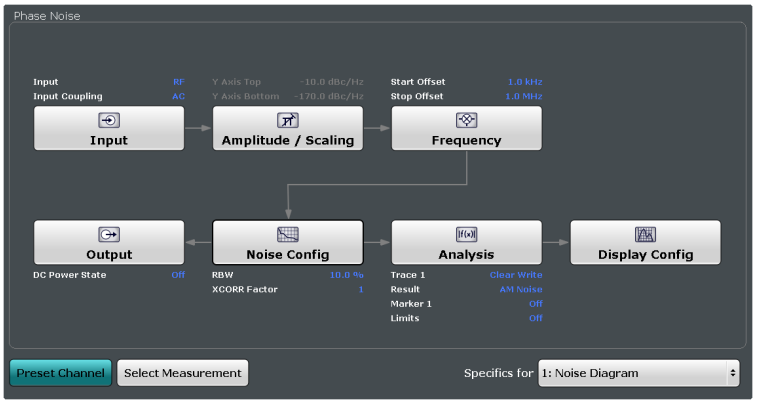
7 Common Measurement Settings

Basic measurement settings that are common to many measurement tasks, regardless of the application or operating mode, are described here. If you are performing a specific measurement task, using an operating mode other than Phase Noise mode, or an application other than the Phase Noise application, be sure to check the specific application or mode description for settings that may deviate from these common settings.

- Configuration Overview....95
- Input Source....97
- Level Characteristics....98
- Frequency....102
- Noise Measurement Configuration....103
- Output....111
- Pulsed Phase Noise Configuration....117

7.1 Configuration Overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Input
   See chapter 7.2, "Input Source", on page 97.
2. Amplitude / Scaling

See chapter 7.3, "Level Characteristics", on page 98.

3. Frequency
   See chapter 7.4, "Frequency", on page 102.
4. Noise
   See chapter 7.5, "Noise Measurement Configuration", on page 103.
5. Output
   See chapter 7.6, "Output", on page 111.
6. Analysis
   See chapter 8, "Common Analysis and Display Functions", on page 120.
7. Display Configuration
   See chapter 6, "Measurements and Result Displays", on page 86.

In addition, the dialog box provides the "Select Measurement" button that serves as a shortcut to select the measurement type.

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

Selecting the noise measurement type 96
Preset Channel 96
Specifics for 97

Selecting the noise measurement type
The R&S FSWP provides a number of different types of measurements to measure the noise characteristics of a DUT.

- Phase Noise
  Phase noise and AM noise measurements for continuous wave signals.
- Additive Noise
  Phase noise and AM noise measurements for continuous wave signals including a signal source.
  Available with the optional Signal Source hardware.
- Pulsed Phase Noise
  Phase noise and AM noise measurements for pulse signals.
  Available with the optional Pulsed Phase Noise measurement application.

More information.

Remote command:
`CONFigure:PNOise:MEASurement` on page 293

Preset Channel
Select the "Preset Channel" button in the lower lefthand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Note that the PRESET key restores the entire instrument to its default values and thus closes **all measurement channels** on the R&S FSWP (except for the default channel)!

See "Preset Mode" on page 191

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 386

Specifics for
The measurement channel may contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specifics for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

7.2 Input Source

The Phase Noise application supports input from several signal sources.

For more information about the available connectors refer to the Getting Started manual.

- RF Input 97

7.2.1 RF Input

The RF Input is the default input source.

Access to RF input settings

► "Overview" > "Input" > "Input Source" > "Radio Frequency" > "Config"

A typical test setup for measurements over the RF input depends on the selected measurement and the equipment used in the test setup. A schematic representation of such a setup is provided in the dialog box.

- The DUT directly sends a signal to the RF input of the R&S FSWP.
- If required, the R&S FSWP can supply the DUT with power over the DC ports.

Access to schematic RF input test setup

► "Overview" > "Input" > "Input Source" > "Radio Frequency" > "Test Setup"

For more information about configuring the DC ports used in the setup see chapter 7.6.1, "DC Source Configuration", on page 111.

The remote commands required to configure the frequency are described in chapter 12.6.1.1, "RF Input", on page 299.

Radio Frequency State 98
Input Coupling 98

Radio Frequency State
Activates input from the RF INPUT connector.

Remote command:
`INPut:SELect` on page 300

Input Coupling
The RF input of the R&S FSWP can be coupled by alternating current (AC) or direct current (DC).

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the data sheet.

Remote command:
`INPut:COUPling` on page 299

7.3 Level Characteristics

Measurement results usually consist of the measured signal levels (amplitudes) displayed on the vertical (y-)axis for the determined frequency spectrum (horizontal, x-axis). The settings for the vertical axis, regarding amplitude and scaling, are described here.

- Signal Attenuation 98
- Amplitude Characteristics 99
- Diagram Scale 101

7.3.1 Signal Attenuation

Signal attenuation reduces the level of the signal that you feed into the R&S FSWP. Reducing the level is necessary to protect the input mixer from signals with high levels, because high levels might cause an overload of the input mixer. An input mixer overload in turn might lead to incorrect measurement results or even damage or destroy the input mixer.

The level at the input mixer is determined by the set RF attenuation according to the formula:

$level_{mixer} = level_{input}$ - RF attenuation

The maximum level that the input mixer can handle is 0 dBm. Levels above this value cause an overload. The R&S FSWP indicates an overload situation by the "RF OVLD" label in the status bar.

The R&S FSWP features a mechanical attenuator. The mechanical attenuator is located directly after the RF input of the R&S FSWP. Its step size is 5 dB.

Effects of the attenuator

Attenuation has a direct effect on the sensitivity of the analyzer - attenuation must be compensated for by re-amplifying the signal levels after the mixer. Thus, high attenuation values cause the inherent noise (or noise floor) to rise, which in turn decreases the sensitivity of the analyzer. The highest sensitivity is obtained at an RF attenuation of 0 dB. Each additional 10 dB of attenuation reduces the sensitivity by 10 dB, i.e. the displayed noise is increased by 10 dB. To measure a signal with an improved signal-to-noise ratio, decrease the RF attenuation.

Another (positive) effect is that high attenuation also helps to avoid intermodulation.

For ideal sinusoidal signals, the displayed signal level is independent of the RF attenuation.

In the default state, the R&S FSWP automatically determines the attenuation according to the signal level that is currently applied. Automatic determination of the attenuation is a good way to find a compromise between a low noise floor, high intermodulation levels, and protecting the instrument from high input levels.

However, you can also define the attenuation manually, if necessary.

7.3.2 Amplitude Characteristics

Amplitude settings allow you to adapt the R&S FSWP for the signal that is fed into its input (for example the RF input).

Access to amplitude settings

► "Overview" > "Amplitude / Scaling" > "Amplitude"

Functionality to configure amplitude characteristics described elsewhere:

- "Input Coupling" on page 98

The remote commands required to configure the amplitude are described in chapter 12.6.3, "Remote Commands to Configure Level Characteristics", on page 311.

Attenuating the signal....99
Shifting the level....100
Searching for the signal level....100

Attenuating the signal

You can either determine the attenuation automatically or manually. Signal attenuation is possible in 5 dB steps. The range is specified in the data sheet.

When you select "Auto" mode, the R&S FSWP determines the attenuation based on the level of the signal that is currently applied. Automatic determiniation of the attenuation makes sure that the ideal attenuation is always selected.

In "Manual" mode, the "Value" field becomes available and you can define an attenuation as required.

NOTICE! Risk of hardware damage due to high power levels.
When you decrease the attenuation manually, make sure that the signal level does not exceed the maximum level allowed at the RF input. Otherwise, an overload of the input mixer may cause hardware damage.

More information

Remote command:
Mode: `INPut:ATTenuation:AUTO` on page 314
Attenuation: `INPut:ATTenuation` on page 313

Shifting the level
You can define an arithmetic level offset that is added to the measured level.

Defining a level offset is useful, for example, if you attenuate or amplify the signal before it is fed into the R&S FSWP. The R&S FSWP is then able to display the correct power results.

To determine the required offset, consider the external attenuation or gain applied to the input signal. For attenuation, define a positive offset so the R&S FSWP increases the displayed power values. If an external gain is applied, define a negative offset so the R&S FSWP decreases the displayed power values.

Remote command:
`[SENSe:]POWer:RLEVel:OFFSet` on page 315

Searching for the signal level
The R&S FSWP automatically measures the level of the signal you have applied and keeps track of the measured signal levels.

The currently measured signal level is displayed in the channel bar.

Note that you should attenuate the signal if its level is too high, especially if you have no idea about the signal strength you are measuring. For more information see "Attenuating the signal" on page 99.

The measurement starts only if the signal level is within the level threshold that you have defined via the "Auto Search" feature.

If the signal level is outside the threshold that you have defined, it is ignored.

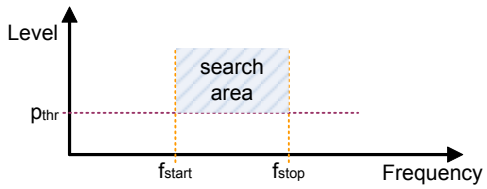


Fig. 7-1: Basic principle of the signal search feature

Remote command:
Signal level: `[SENSe:]POWer:RLEVel?` on page 314
Threshold: `[SENSe:]ADJust:CONFigure:LEVel:THReshold` on page 314

7.3.3 Diagram Scale

The scale settings define the scale of the y-axis in graphical result displays.

Access to diagram scale settings

► "Overview" > "Amplitude / Scaling" > "Scale"

The remote commands required to configure the amplitude are described in chapter 12.6.3, "Remote Commands to Configure Level Characteristics", on page 311.

Scaling the y-axis 101

Scaling the y-axis
You can scale the y-axis of graphical result displays automatically or manually.

Scaling the axis automatically has the advantage that the aplication automatically selects the ideal scale for the current measurement results. When you select the "Auto" scale mode, the R&S FSWP adjusts the scale of the axis during the measurement.

When you select the "Manual" scale mode, you can select any scale that suits your needs. You can scale the axis by the following logic:

- Define a "Top" and "Bottom" value. The "Range" is adjusted accordingly.
- Define a "Top" value and a "Range". The "Bottom" value is adjusted accordingly.
- Define a "Range" and a "Bottom" value. The "Top" value is adjusted accordingly.
- When you change the "Top" or "Bottom" values only, the "Range" is adjusted.
- When you change the "Range" only, the "Bottom" value is adjusted.

In addition, you can perform a single automatic scale adjustment with the "Auto Scale Once" feature. When you do so, the R&S FSWP selects the ideal scale for the current measurement results, but will not update the scale for the next measurement.

Remote command:
Mode: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO` on page 312
Top: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 313
Bottom: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:LOWer` on page 313
Range: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]` on page 312

7.4 Frequency

Frequency settings allow you to control the characteristics of the measurement frequency.

Access to carrier frequency settings

► "Overview" > "Frequency"

Access to measurement range settings

► "Overview" > "Noise Config" > "Noise Config"

The remote commands required to configure the frequency are described in chapter 12.6.4, "Remote Commands to Configure the Frequency", on page 315.

Defining the signal frequency 102
Searching for a signal 102
Definining the measurement range 103

Defining the signal frequency
The "Signal Frequency" is the frequency the signal is transmitted with.

You can define it manually in the corresponding input field or let the R&S FSWP search for the signal frequency in an automatic frequency search (turn on the "Auto Search" in that case).

Remote command:
`[SENSe:]FREQuency:CENTer` on page 316

Searching for a signal
The R&S FSWP automatically scans the frequency spectrum for any signals before a phase noise measurement begins. If it can find a signal on any frequency, it starts a measurement on that frequency.

The current signal frequency is displayed in the channel bar.

In case you already know the signal frequency, you can also turn off the automatic search and define it manually.

The measurement starts only if a signal is present within the frequency search limits that you have defined via the "Auto Search" feature. The search range is defined by a minimum and maximum value. The maximum frequency range that you can scan depends on the hardware you are using. Note that a signal must also be within a certain level range for it to be detected.

No measurement will be initiated if no signal can be found in the frequency search range you have defined.

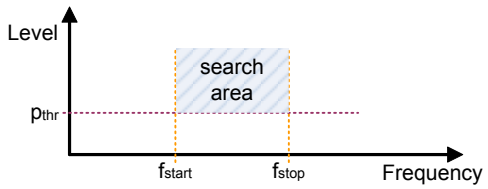


Fig. 7-2: Basic principle of the signal search feature

During a frequency scan, the R&S FSWP steps through the frequency search range you have defined in a predefined step size (one step usually covers the full I/Q bandwidth).

Remote command:
Signal frequency: `[SENSe:]FREQuency:CENTer` on page 316
Mode: `[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe]` on page 315
Lower search limit: `[SENSe:]ADJust:CONFigure:FREQuency:LIMit:LOW` on page 316
Upper search limit: `[SENSe:]ADJust:CONFigure:FREQuency:LIMit:HIGH` on page 316

Definining the measurement range
Noise measurements determine the noise of a DUT over a particular measurement range. The measurement range is defined by the two offset frequencies that you define ("Start Offset" and "Stop Offset").

The frequency offsets themselves are relative to the carrier frequency of the DUT: a frequency offset of 1 MHz, for example, measures the noise characteristics at a distance of 1 MHz from the carrier. The maximum offset that you can define depends on the hardware you are using.

Note: In case of Pulsed Phase Noise measurements, the maximum offset is limited to 30 MHz.

The measurement range thus defines the scale of the x-axis in the Phase Noise diagram.

The measurement range again is divided into several (logarithmic) decades, or, for configuration purposes, into half decades (➙ More information).

Remote command:
Start offset: `[SENSe:]FREQuency:STARt` on page 317
Stop offset: `[SENSe:]FREQuency:STOP` on page 317

7.5 Noise Measurement Configuration

Noise measurements are performed based on several specific measurement parameters.

- Measurement Range....104
- Measurement Range Configuration....104
- Integrated Measurement Configuration....107
- Spot Noise Information....110

7.5.1 Measurement Range

Noise measurements determine the noise characteristics of a DUT over a particular measurement range. This **measurement range** is defined by two offset frequencies. The **frequency offsets** themselves are relative to the nominal frequency of the DUT.

The measurement range again is divided into several (logarithmic) decades, or, for configuration purposes, into **half decades**.

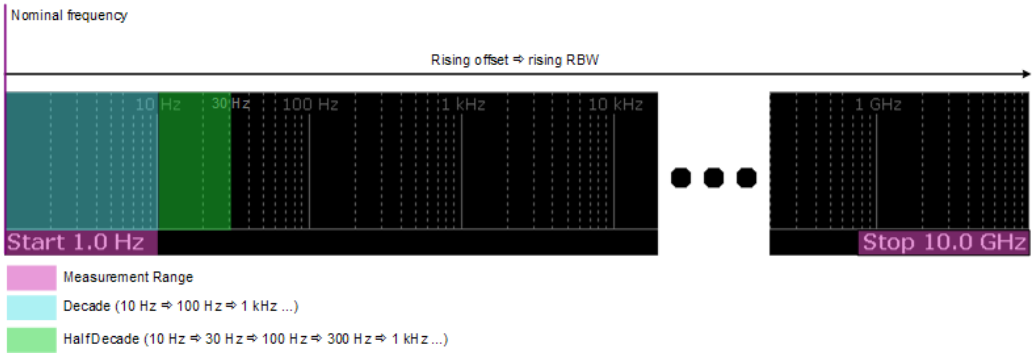

Nominal frequency
Rising offset ⇨ rising RBW
10 Hz
30 Hz
100 Hz
1 kHz
10 kHz
1 GHz
Start 1.0 Hz
Stop 10.0 GHz
Measurement Range
Decade (10 Hz ⇨ 100 Hz ⇨ 1 kHz ...)
HalfDecade (10 Hz ⇨ 30 Hz ⇨ 100 Hz ⇨ 300 Hz ⇨ 1 kHz ...)

Fig. 7-3: Measurement range and half decades

This breakdown into several half decades is made to speed up measurements. See "Working with the half decade configuration table" on page 107 for more information about the measurement configuration in each half decade.

The main issue in this context is the **resolution bandwidth** (RBW) and its effect on the measurement time. In general, it is best to use a resolution bandwidth as small as possible for the most accurate measurement results. However, accuracy comes at the price of measurement speed.

To avoid very long measurement times, the application provides only a certain range of RBW that are available for each half decade.

7.5.2 Measurement Range Configuration

The measurement range parameters define the way the phase noise of a DUT is measured.

Access to measurement range settings

► "Overview" > "Noise Config" > "Noise Config"

The remote commands required to configure the measurement range are described in chapter 12.6.5.1, "Measurement Range Configuration", on page 317.

Functions to configure the measurement range described elsewhere:

- Start Offset
- Stop Offset

Defining the resolution bandwidth 105
Defining cross-correlation parameters 105
Turning the display of the cross-correlation gain indicator on and off 106
Sweep / Average Count 106
Estimating the measurement time 107
Working with the half decade configuration table 107

Defining the resolution bandwidth

The resolution bandwidth (RBW) is the filter bandwidth applied during the noise measurement. Noise measurements apply a different resolution bandwidth to each half decade that is measured: small bandwidths for small frequency offsets and higher bandwidths for larger frequency offsets (to speed up the measurement on larger frequency offsets).

The resolution bandwidth that is applied to each half decade is a function of the frequency offset. By default, the resolution bandwidth is 10 % of the start offset of the half decade. If the start offset is, for example 10 kHz, the resulting resolution bandwidth is 1 kHz.

If required, you can change the resolution bandwidth factor. A selected set of percentages in the range from 0.1 % to 30 % is supported.

Remote command:
`[SENSe:]LIST:BWIDth[:RESolution]:RATio` on page 318

Defining cross-correlation parameters

Cross-correlation is a method to calculate the noise characteristics more precisely by routing the signal through two oscillators. The signal has the same noise characteristics in both channels while the oscillators have different noise characteristics. Through cross-correlation operations, the noise of the DUT can be calculated very accurately.

The number of cross-correlation operations that are performed depends on the half decade that is measured. Small offsets (which usually have a higher noise level) require fewer operations to get accurate results, while large offsets (whose noise levels can be very low) require more operations for accurate results.

The base number of the first half decade is a fixed value. The number of operations for the other half decades is determined in such a way, that all operations are finished at roughly the same time.

Example:

The operations in the first half decade need 1 s to finish. The number of operations done in the other half decades is calculated with respect to this 1 s time frame. For example, if the application can perform 10 cross-correlation operations in 1 s in another half decade, it will do so, but no more than that number.

You can control the number of cross-correlations for the first half decade with the cross-correlation factor ("XCORR Factor"). By multiplying this value with the base number of operations for the first half decade, the application calculates the time it takes to perform these operations in the first half decade and then adjusts the number of operations for all other half decades.

When you turn the "XCORR Optimize" feature on, the number of operations in each half decade is the maximum number of operations to be done in that half decade. In that case, cross-correlation operations are only performed as long as the measurement results still improve. When this is not the case, the R&S FSWP stops calculating results, even when the selected number of operations has not yet been reached. This is thus a good tool to speed up the measurement.

Example:

The number of operations in a half decade is 30. When optimization is on, and the results do not improve any more after 20 operations, the application stops measurements in that half decade.

Remote command:
Factor: `[SENSe:]SWEep:XFACtor` on page 321
Optimization: `[SENSe:]SWEep:XOPTimize` on page 321

Turning the display of the cross-correlation gain indicator on and off
The phase noise diagram contains a grey area in its default state. This area represents the cross-correlation gain indicator.

It shows the rejection of uncorrelated noise dependent on the number of correlation averages. If the measurement trace itself lies on the cross-correlation gain indicator, further correlation will reduce the phase noise value. If some distance between the cross-correlation gain indicator and the measurement result is obtained, further correlation will not reduce the phase noise value any more, but only smooth the trace. When you turn on the"Optimize XCORR" feature, he measurement stops automatically when the gap between the cross-correlation gain indicator and the measurement trace exceeds 10 dB.

You can turn the display of the grey area on and off as required.

Remote command:
`DISPlay:XGINdicator[:STATe]` on page 318

Sweep / Average Count
Defines the number of measurements to be performed in the single sweep mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one measurement is performed.

The sweep count is applied to all the traces in all diagrams.

In case of the "Average" trace mode, the sweep count also determines the number of individual measurements used to average the trace.

In continuous sweep mode, a sweep count = 0 (default) calculates a moving average over 10 measurements. A sweep count = 1 calculates no averages.

Remote command:
`[SENSe:]SWEep:COUNt` on page 320

Estimating the measurement time
Based on the parameters you have defined for the noise measurement, the application estimates the total measurement time required to measure the noise characteristics over all half decades. It is displayed in the "Meas Time Estimated" field of the "Noise Config" dialog box and in the channel bar ("Meas Time" label).

The measurement time is function of the resolution bandwidth, cross-correlation factor and the number of averages performed in the measurement.

More information

Remote command:
`[SENSe:]SWEep:TIME?` on page 320

Working with the half decade configuration table
The half decade configuration table shows the measurement characteristics for each half decade that is part of the measurement.

The table is read only, the values in the table depend on the settings you have made for the noise measurements. The size (number of rows) depends on the number of half decades that you have defined.

The table contains the following values.

- **Start Offset**
  Start frequency offset of the half decade.
  Depends on the frequency offsets you have defined.
- **Stop Offset**
  Stop frequency offset of the half decade.
  Depends on the frequency offsets you have defined.
- **RBW**
  Resolution bandwidth applied to the corresponding half decade during the measurement.
  Depends on the resolution bandwidth factor you have defined.
- **XCORR**
  Shows the number of cross-correlation operations applied in the corresponding half decade.
  Depends on the XCORR factor you have defined.

Remote command:
Start offset: `[SENSe:]LIST:RANGe<r>:FREQuency:STARt?` on page 319
Stop offset: `[SENSe:]LIST:RANGe<r>:FREQuency:STOP?` on page 319
RBW: `[SENSe:]LIST:RANGe<r>:BWIDth[:RESolution]?` on page 318
XCORR: `[SENSe:]LIST:RANGe<r>:XCOunt?` on page 319

7.5.3 Integrated Measurement Configuration

You can control the integration ranges and data source (traces) that the calculations for integrated measurement results are based on.

Access to integrated measurements settings

► "Overview" > "Noise Config" > "Integrated Measurements"

The remote commands required to configure residual calculations are described in chapter 12.6.5.2, "Residual Calculation Configuration", on page 321.

Selecting the trace for residual calculations....108
Defining the integration range....108
Working with weighting filters....108
└ Applying weighting filters....108
└ Managing weighting filters....109
└ Designing weighting filters....109

Selecting the trace for residual calculations
Residual calculations are only performed when you select an (active) trace that serves as the data source (when the selected trace is inactive, residual effects are not calculated).

You can select any trace as the data source ("Trace 1" to "Trace 6" in the dropdown menu), and define the frequency range over which the integration is performed.

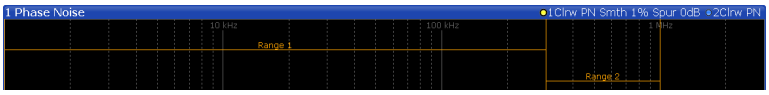
When you select "None" from the dropdown menu, residuals effects are not calculated.

Remote command:
`CALCulate<n>[:RANGe<r>]:EVALuation:TRACe` on page 322

Defining the integration range
You can define up to four integration ranges on different traces.

By default, the R&S FSWP integrates over the entire frequency range defined for the measurement (Range = "Meas"). You can, however, also define custom integration ranges (Range = "Manual").

In that case, the input fields next to the "Range" control become available to define a customized integration range. The application shows orange lines ("Range <x>") in the graphical result display to indicate custom ranges.



Remote command:
State: `CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]` on page 323
Start: `CALCulate<n>[:RANGe<r>]:EVALuation:STARt` on page 321
Stop: `CALCulate<n>[:RANGe<r>]:EVALuation:STOP` on page 322

Working with weighting filters
The weighting filter feature provides functionality to correct integrated measurements and thus compensate for external effects that affect the results in certain frequency ranges. A weighting filter is a useful feature if you already know that this is the case and would like to compensate for these effects.

Note that the weighting filter only has an effect on the integrated measurement results and has no effect in the noise diagram or other numerical results.

Applying weighting filters ← Working with weighting filters
When you apply a weighting filter, the R&S FSWP takes the correction values defined in the weighting filter into account for the calculation of integrated measurements.

The "Weighting Filter" dropdown menu contains all weighting filters that are available on the internal hard disk of the R&S FSWP.

Remote command:
`CALCulate<n>[:RANGe<r>]:EVALuation:WEIGhting` on page 323

Managing weighting filters ← Working with weighting filters
The table in the "Residual Calculations" dialog box shows all currently available weighting filter.

From this dialog box, you have the following options.

- Edit a weighting filter that already exists (→ "Edit").
- Create a new weighting filter (→ "New").
- Create a new weighting filter based on an existing one (→ "Copy").
  If required, you can delete the selected filter at any time (→ "Delete").

Each of the options opens a dialog box that contains the functionality to characterize a weighting filter.

Remote command:
Select a filter: `[SENSe:]CORRection:WEIGhting:SELect` on page 325
Delete: `[SENSe:]CORRection:WEIGhting:DELete` on page 324

Designing weighting filters ← Working with weighting filters
The R&S FSWP provides the following tools to design a weighting filter.

- "Name" / "Comment"
  Defines a name and / or comment of the weighting filter. The name defines the label by which the filter appear in the "Weighting Filter" dropdown menu.
- "Position" and "Value"
  Define the data points of the weighting filter (including a graphical preview).
  They define by which amount (dB) residual effects are corrected for specific frequencies. For example. you could say that at a frequency of 100 MHz, the residual effects are corrected by 5 dB.
- "Insert Value"
  Inserts a weighting filter data point. Alternatively, you can click in the table itself to add a new data point.
- "Delete Value"
  Deletes the currently selected data point. The currently selected data point is highlighted blue.
- "Shift X" / "Shift Y"
  Shifts all data points of the weighting filter horizontally or vertically by a certain amount.
- "Save"
  Saves and stores the weighting filter on the internal hard disk of the R&S FSWP.

A weighting filter may consist of up to 625 data points. Each data point is a pair of values: the first value describes the frequency, the second value describes the level (correction value) for that frequency.

Frequencies have to be entered in ascending order and may not overlap.

When you save the filter, the R&S FSWP uses the name of the weighting filter as the file name. If a weighting filter of the same name already exists, the R&S FSWP will ask before it overwrites the existing file.

Remote command:
Name: [SENSe:]CORRection:WEIGhting:NAME on page 324
Comment: [SENSe:]CORRection:WEIGhting:COMMent on page 323
Data: [SENSe:]CORRection:WEIGhting:DATA on page 324

7.5.4 Spot Noise Information

Spot noise is the phase noise measured at a certain offset frequency. The information about spot noise is provided in the noise diagram (optionally) and in a separate spot noise information table.

The R&S FSWP provides several features to control the spot noise information.

Access to spot noise settings

► "Overview" > "Noise Config" > "Spot Noise"

The remote commands required to configure spot noise measurements are described in chapter 12.6.5.3, "Spot Noise Configuration", on page 325.

Displaying spot noise information 110
Selecting the spot noise positions 110

Displaying spot noise information
By default, when you perform a measurement, the R&S FSWP displays the spot noise information in the diagram area.

You can turn off the displayed spot noise information any time, for example if you want a better view of the measurement results.

You can also select the trace the displayed spot noise information refers to from the "Trace" dropdown menu.

Remote command:
DISPlay:SNINfo[:STATe] on page 328
DISPlay:SNINfo:TRACe on page 328

Selecting the spot noise positions
The R&S FSWP provides several methods to define the positions where the spot noise is measured.

By default, it calculates the spot noise on all "Decade Edges" (10^x offset frequencies) in the measurement range. Therefore, the number of spot noise results depends on the measurement range.

If you want to evaluate the spot noise on positions other than the decade edges, you can add "User Defined" spot noise positions. When you turn that feature on, changes that you make to the "Offset" input fields are considered in the current measurement (by default, user defined spot noise positions are the decade edges).

You can define any offset frequency that is part of the measurement range as a new spot noise position. To exclude an offset frequency, uncheck the checkbox of the current offset.

The results for the user defined spot noise positions are displayed in the Spot Noise table in addition to the decade edge spot noise results.

When you turn off the "Decade Edges" spot noise positions, the Spot Noise table contains only the user defined spot noise positions.

Remote command:
See chapter 12.6.5.3, "Spot Noise Configuration", on page 325.

7.6 Output

The Phase Noise application is able to provide different kinds of output for various purposes.

For more information about the available connectors refer to the Getting Started manual.

- DC Source Configuration 111
- Signal Source Configuration 114
- Miscellaneous Output 116

7.6.1 DC Source Configuration

The "DC Power" settings allow you to configure the DC power supply sources available on the front panel for different purposes.

Proper configuration of the DC ports

Setting DC voltages and currents properly is an important step during the configuration in order not to damage the device under test (DUT) by applying too much voltage or current!

Therefore it is recommended to connect the device under test (DUT) to the instrument after the DC settings have been made and verified.

Access to all DC port settings

► "Overview" > "Output" > "Output" > "DC Config"

Easy access to the most relevant DC port settings

► (in the toolbar)

Easy change of the state of DC ports

► (in the toolbar)

The remote commands required to configure the DC power output are described in chapter 12.6.2, "Output", on page 300.

Turning the DC output on and off....112
Coupling the output configuration across measurement channels....112
Configuring the DC power output....112
└ Turning the output on and off....113
└ Selecting the output type (Vsupply only)....113
└ Defining the output level....113
└ Reading the actual output levels....114

Turning the DC output on and off

DC output power is only supplied when you turn on the DC power output in general with the "DC Power" feature, and then turn on the individual voltage supplies V_{supply}, V_{tune} or V_{aux} (→ Output State).

When you turn off DC power supply in general, no power is supplied, even when the indivdual outputs have been turned on.

Remote command:
`SOURce:VOLTage[:STATe]` on page 309

Coupling the output configuration across measurement channels

You can couple the configuration of the DC power output and the (optional) signal source output across all active measurement channels.

When you turn on coupling, all active measurement channels apply the same configuration.

When you turn off coupling, you can define a different configuration for each measurement channel.

Remote command:
DC power: `SOURce:VOLTage:CHANnel:COUPling` on page 304
Signal source: `SOURce:GENerator:CHANnel:COUPling` on page 310

Configuring the DC power output

The R&S FSWP features three outputs that allow you to supply external devices like the DUT or external measurement equipment with DC power.

The outputs are labeled "V_{supply}" (supply voltage), "V_{tune}" (tuning voltage) and "V_{aux}" (auxiliary voltage). Each of the outputs has different characteristics regarding the supported voltage range and maximum output current, and is thus designed for different purposes.

For more information about the output connectors, please refer to the Getting Started.

Basically, you can define the same parameters for all three outputs.

- "Turning the output on and off" on page 113
- "Selecting the output type (Vsupply only)" on page 113
- "Defining the output level" on page 113
- "Reading the actual output levels" on page 114

Turning the output on and off ← Configuring the DC power output
Apart from the general DC power output state, you can turn each individual output on and off. Output is generated only, when the required DC output is actually turned on.

By default, all outputs are turned off. When you want to use one of the outputs, turn it on.

Remote command:
V_{supply}: `SOURce:VOLTage:POWer<i>:LEVel[:STATe]` on page 307
V_{tune}: `SOURce:VOLTage:CONTrol<i>:LEVel[:STATe]` on page 305
V_{aux}: `SOURce:VOLTage:AUX:LEVel[:STATe]` on page 303

Selecting the output type (Vsupply only) ← Configuring the DC power output
The supply voltage output (V_{supply}) supports variable voltages as well as variable current. For this output, you can select whether you want to control the output in terms of current or voltage.

When you select "Voltage", you can define the output in terms of the voltage that is supplied. The supplied current is adjusted accordingly (up to the maximum current you have allowed).

When you select "Current", you can define the output in terms of the current that is supplied. The supplied voltage is adjusted accordingly (up to the maximum voltage you have allowed).

The other outputs are already limited regarding the output current; only the voltage is variable for these.

Note: When you switch between "Voltage" and "Current", DC output is turned off as a precaution. You have to turn it on again deliberately.

Remote command:
`SOURce:VOLTage:POWer<i>:LEVel:MODE` on page 307

Defining the output level ← Configuring the DC power output
For all three outputs, you can control the voltage that should be output to supply the DUT or other devices. The supported voltage range is different for each output (see datasheet for details).

In addition to the hardware limits regarding the range of output values, you can also define soft limits. These soft limits limit the output to a range that suits your needs. They thus help you to avoid accidentally defining an output level that is too high for the DUT you are testing.

Note that when you change the output voltage while a measurement is running, this measurement is aborted and restarted.

Controlling the supply current for the V_{supply} output

For the supply voltage output (V_{supply}), you can select whether you want to control the output in terms of current or voltage (→ Output Type).

If you select output type "Voltage", you can define the output level and limits in terms of voltage (the current is adjusted, if required).

If you select output type "Current", you can define the output level and limits in terms of current (the voltage is adjusted, if required) . In that case, the range defining the soft limits are also defined in terms of current.

In addition, you can define the maximum output current (or voltage) that is supplied in the "Max Curr / Volt" field.

For the other two outputs (V_{tune} and V_{aux}), the maximum current that can drawn by the DUT is fixed to the value supported by the hardware. The "Max Curr / Volt" information is read only information for these two.

Remote command:
Level V_{supply}: `SOURce:VOLTage:POWer<i>:LEVel:AMPLitude` on page 306
Level V_{tune}: `SOURce:VOLTage:CONTrol<i>:LEVel:AMPLitude` on page 304
Level V_{aux}: `SOURce:VOLTage:AUX:LEVel:AMPLitude` on page 303
Limits V_{supply}: `SOURce:VOLTage:POWer<i>:LEVel:LIMit:LOW` on page 307 / `SOURce:VOLTage:POWer<i>:LEVel:LIMit:HIGH` on page 306
Limits V_{tune}: `SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:LOW` on page 305 / `SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:HIGH` on page 304
Limits V_{aux}: `SOURce:VOLTage:AUX:LEVel:LIMit:LOW` on page 303 / `SOURce:VOLTage:AUX:LEVel:LIMit:HIGH` on page 303
Max. V / A: `SOURce:VOLTage:POWer<i>:LIMit:HIGH` on page 308

Reading the actual output levels ← Configuring the DC power output
The actual output levels (voltage and current) for each output source is displayed in the "Results" part of the dialog box.

When the output levels are as you have defined them, the font of these result values is green. If the voltage or current that is output differs from the values that you have defined, the font turns red.

This may be the case , for example. if the DUT draws too much current, and the voltage required for that current would exceed the limits you have defined.

Remote command:
Voltage: `SOURce:VOLTage:SEQuence:RESult?` on page 308
Current: `SOURce:CURRent:SEQuence:RESult?` on page 302
Power: `SOURce:POWer:SEQuence:RESult?` on page 302

7.6.2 Signal Source Configuration

The "Signal Source" settings allow you to configure output of the signal source output. The signal source generates a simple sine signal that you can feed into the DUT.

The output is available when you have installed the optional hardware component.

NOTICE

Risk of damage to the instrument or DUT

Make sure that the DUT can handle the signal power that you output via the signal source. Power levels that are too high might damage the DUT.

Make also sure that the reflected power does not exceed 30 dBm. Power levels higher than that might damage or destroy the signal source output.

Access to all signal source settings

► "Overview" > "Output" > "Output" > "Signal Source"

Easy access to the most relevant DC port settings

► (in the toolbar)

Easy change of the state of DC ports

► (in the toolbar)

The remote commands required to configure the signal source output are described in chapter 12.6.2.2, "Signal Source", on page 309.

Functions to configure the signal source output described elsewhere:

- "Coupling the output configuration across measurement channels" on page 112

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Turning the signal source output on and off
A signal from the signal source is supplied only if you turn it on with the "Source Power" feature.

Otherwise, the signal source output remains inactive.

Remote command:
`SOURce:GENerator[:STATe]` on page 311

Defining the signal characteristics
The signal source generates a simple sine signal whose general characteristics can be defined arbitrarily.

- "Frequency"
  Defines the frequency of the signal.
- "Level"
  Defines the signal level.
  When you define the signal level, make sure that your DUT can handle the power that you have defined. Otherwise, the DUT can be damaged.

Remote command:
`SOURce:GENerator:FREQuency` on page 310
`SOURce:GENerator:LEVel` on page 310

Bypassing the DUT
The "DUT Bypass" feature measures the noise of the R&S FSWP.

This may come in handy when measuring the additive noise, and you would like to draw a trace that shows the contribution of the R&S FSWP to the overal noise characteristics.

The feature is available for Additive Noise measurements.

Remote command:
SOURce:GENerator:DUTBypass on page 309

7.6.3 Miscellaneous Output

The "General Output" dialog box contains settings that allow you to configure various outputs available on the R&S FSWP.

Access to miscellaneous output settings

► "Overview" > "Output" > "Output"

The remote commands required to configure miscellaneous output are described in chapter 12.6.2.3, "Miscellaneous Output", on page 311.

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- Output Configuration....116

7.6.3.1 Background Information

- Input from Noise Sources....116

Input from Noise Sources

The R&S FSWP provides a connector (NOISE SOURCE CONTROL) with a voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off in the firmware, you can activate or deactive the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSWP itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S FSWP and measure the total noise power. From this value you can determine the noise power of the R&S FSWP. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

The noise source is controlled in the "Output" settings, see "Noise Source" on page 116

7.6.3.2 Output Configuration

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Noise Source
Switches the supply voltage for an external noise source on or off.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSWP itself, for example when measuring the noise level of a DUT.

For details see "Input from Noise Sources" on page 116

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 311

7.7 Pulsed Phase Noise Configuration

When you equip the R&S FSWP with the optional Pulsed Phase Noise Measurement application, the R&S FSWP provides functionality to measure the phase noise of pulsed signals.

This measurement mode only measures the phase noise during the time the pulse is transmitted, like a gated measurement does in a spectrum analyzer. In order for the measurement to work, the application needs to know the pulse characteristics, so it can open up a gate during which it records and analyzes the signal data.

If required, the application is able to detect a pulse in the frequency spectrum. When one has been found, it can also detect pulse characteristics automatically.

Of course, you can omit the signal search and automatic pulse characterisation and instead define these parameters manually.

Access pulsed phased noise measurement

► MEAS > "Pulsed Phase Noise"

Access to pulsed phased noise measurement settings

► "Overview" > "Pulse"

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Defining preview diagram characteristics
The application provides some feature that scale the "Preview" diagram shown in the dialog box.

The "Measurement Time" defines scale of the x-axis.

The "Pretrigger" defines an offset from the origin of the x-axis.

Both parameters have no effect on the actual measurement of the noise characteristics of the pulse.

Remote command:
not supported

Selecting the pulse detection mode
The easiest way to set up pulsed phase noise measurements is to let the application detect the pulse characteristics and configure the measurement accordingly. This is especially useful when you are measuring an unknown pulse.

After the pulse has been found, the application configure the following parameters:
- Pulse repetition interval
- Gate level
- Gate delay
- Gate length (in case of Gate Type = Edge)

You can also start the detection of the pulse characteristics deliberately with the "Auto Detect Once" feature.

When you already know the pulse characteristics, you can also configure the measurement manually by selecting "Manual" mode and entering the values as required.

Remote command:
`[SENSe:]SWEep:PULSe:DETection` on page 330

Defining the pulse repetition interval
The "Pulse Repetition Interval" defines the time between two consecutive pulse edges of the same polarity in seconds (requires at least two measured pulses). It thus defines the (statistical) frequency with which a pulse is transmitted.

In the default state, when automatic pulse detection is on, the application automatically determines the pulse repetition interval. If required, and you already know that value, you can also enter it directly in the corresponding input field.

In the preview diagram, the pulse repetition interval is indicated by a turquoise bar.

Remote command:
`[SENSe:]SWEep:PULSe:PRI` on page 331

Defining the gate characteristics
Gate characteristics define the type and shape of the gate.

Data is only acquired when the gate is active during the ON time of a pulse. Data transmitted during the OFF time of the pulse is ignored and thus not considered in the noise analysis. This method makes sure that the broadband noise that is present between pulses does not affect the noise results.

Selecting the gate type ← Defining the gate characteristics
The Phase Noise application supports several "Gate Types".

- **Level**
  The gate opens and starts the measurement when the signal exceeds a certain level, and stops when the level drops below that value.
- **Edge**
  The gate opens and starts the measurement when the signal exceeds a certain level, and stops after a certain time defined by the gate length.
- **Off**
  No gate is used during the measurement, and the data during the OFF time of the pulse is also recorded and analyzed.
  You can turn off the gate, for example, when you expect only low noise with little effect on the measurement results during the OFF time of the pulse.

Note that a low pass filter that filters fundamentals and makes sure that only the pulse is analyzed is still active when you turn off the gate.

Note that even when automatic pulse detection is on, you still can select the gate type, if necessary.

Remote command:
Gate type: `[SENSe:]SWEep:EGATe:TYPE` on page 330

Defining the shape of the gate ← Defining the gate characteristics
The shape of the gate is defined by several parameters that is visualized in the "Preview" diagram.

In the default state, when automatic pulse detection is on, the gate characteristics are determined based on the pulse characteristics. In that case, changes here not necessary.

The "Gate Level" defines the signal level that opens the gate. As long as the signal level is below the gate level, no data is recorded. When the signal level rises above the gate level, the measurement starts. In case of the "Gate Type: Level", the gate level also defines the moment when the gate closes, and data acquistion stops.

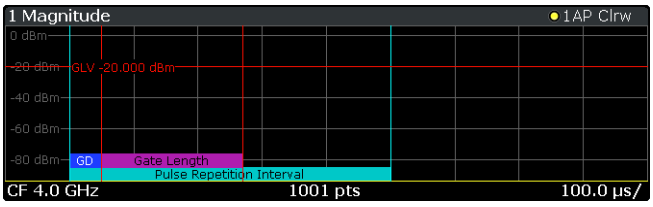
In the preview diagram, the gate level is indicated by a red horizontal line. A label also indicates that currently defined gate level.

The "Gate Delay", if not 0, defines a time offset between the moment the level rises above the gate level (= the beginning of the pulse) and the actual start of the measurement. When you define a gate delay, the first few measurement points after the gate opens are not considered in the measurement results.

In the preview diagram, the gate delay is indicated by a blue bar. The actual starting point of data acquisition is indicated by a red vertical line in the preview diagram.

The "Gate Length" defines the time period that the gate is open. It is closed when the time define by the gate length has elapsed. The gate length is only available for "Gate Type: Edge".

In the preview diagram, the gate length is indicated by a magenta colored bar. The end of the gate in that case is indicated by second red vertical line.



Remote command:
Level: `[SENSe:]SWEep:EGATe:LEVel` on page 330
Delay: `[SENSe:]SWEep:EGATe:HOLDoff` on page 329
Length: `[SENSe:]SWEep:EGATe:LENGth` on page 329

8 Common Analysis and Display Functions

General methods and basic settings to display and analyze measurements, regardless of the operating mode, are described here. If you are performing a specific measurement task, using an operating mode other than Signal and Spectrum Analyzer mode, or an application other than the Spectrum application, be sure to check the specific application or mode description for settings and functions that may deviate from these common settings.

- Result Display Configuration....120
- Zoomed Displays....125
- Trace Configuration....129
- Markers....138
- Limit Lines....145

8.1 Result Display Configuration

Measurement results can be evaluated in many different ways, for example graphically, as summary tables, statistical evaluations etc. Thus, the result display is highly configurable to suit your specific requirements and optimize analysis. Here you can find out how to optimize the display for your measurement results.

General display settings that are usually configured during initial instrument setup, independently of the current measurement, e.g. which items or colors are displayed on the screen, are described in chapter 10.3, "Display Settings", on page 198.

- Basic Result Displays....120
- Laying out the Result Display with the SmartGrid....120

8.1.1 Basic Result Displays

Measurement results can be displayed and evaluated using various different methods, also at the same time. Depending on the currently selected measurement, in particular when using optional firmware applications, not all evaluation methods are available.

The result displays described here are available for most measurements in the Phase Noise application.

Find a list of supported result displays in chapter 6, "Measurements and Result Displays", on page 86.

8.1.2 Laying out the Result Display with the SmartGrid

Measurement results can be evaluated in many different ways, for example graphically, as summary tables, statistical evaluations etc. Each type of evaluation is displayed in a separate window in the channel tab. Up to 16 individual windows can be displayed per measurement channel (i.e. per tab). To arrange the diagrams and tables

on the screen, the Rohde & Schwarz SmartGrid function helps you find the target position simply and quickly.

Principally, the layout of the windows on the screen is based on an underlying grid, the SmartGrid. However, the SmartGrid is dynamic and flexible, allowing for many different layout possibilities. The SmartGrid functionality provides the following basic features:

- Windows can be arranged in columns or in rows, or in a combination of both.
- Windows can be arranged in up to four rows and four columns.
- Windows are moved simply by dragging them to a new position on the screen, possibly changing the layout of the other windows, as well.
- All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar. If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. The same evaluation method can be displayed in multiple windows simultaneously.
- New windows are added by dragging an evaluation icon from the evaluation bar to the screen. The position of each new window depends on where you drop the evaluation icon in relation to the existing windows.
- All display configuration actions are only possible in SmartGrid mode. When SmartGrid mode is activated, the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

- Background Information: The SmartGrid Principle....121
- How to Activate SmartGrid Mode....123
- How to Add a New Result Window....123
- How to Close a Result Window....124
- How to Arrange the Result Windows....124

8.1.2.1 Background Information: The SmartGrid Principle

SmartGrid display

During any positioning action, the underlying SmartGrid is displayed. Different colors and frames indicate the possible new positions. The position in the SmartGrid where you drop the window determines its position on the screen.

Fig. 8-1: Moving a window in SmartGrid mode

The brown area indicates the possible "drop area" for the window, i.e. the area in which the window can be placed. A blue area indicates the (approximate) layout of the window as it would be if the icon were dropped at the current position. The frames indicate the possible destinations of the new window with respect to the existing windows: above/below, right/left or replacement (as illustrated in figure 4-2). If an existing window would be replaced, the drop area is highlighted in a darker color shade.

Positioning the window

The screen can be divided into up to four rows. Each row can be split into up to four columns, where each row can have a different number of columns. However, rows always span the entire width of the screen and may not be interrupted by a column. A single row is available as the drop area for the window in the SmartGrid. The row can be split into columns, or a new row can be inserted above or below the existing row (if the maximum of 4 has not yet been reached).

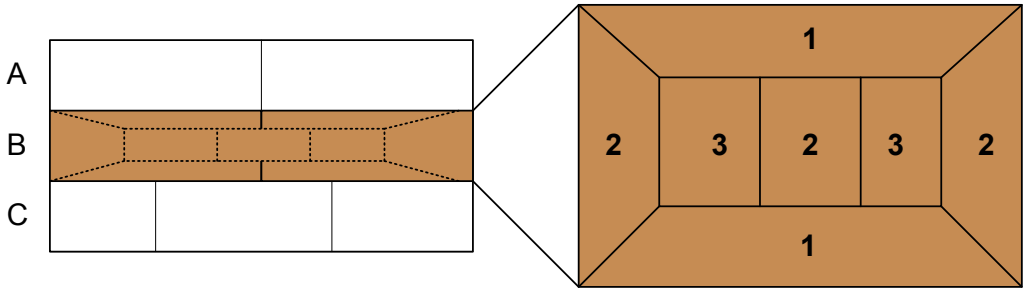


Fig. 8-2: SmartGrid window positions

1 = Insert row above or below the existing row
2 = Create a new column in the existing row
3 = Replace a window in the existing row

SmartGrid functions

Once the evaluation icon has been dropped, icons in each window provide delete and move functions.

The "Move" icon allows you to move the position of the window, possibly changing the size and position of the other displayed windows.

The "Delete" icon allows you to close the window, enlarging the display of the remaining windows.

8.1.2.2 How to Activate SmartGrid Mode

All display configuration actions are only possible in SmartGrid mode. In SmartGrid mode the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

► To activate SmartGrid mode, do one of the following:

-

  Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the configuration "Overview".
- Select the "Display Config" softkey from the MEAS CONFIG menu.

The SmartGrid functions and the evaluation bar are displayed.

To close the SmartGrid mode and restore the previous softkey menu select the "Close" icon in the right-hand corner of the toolbar, or press any key.

8.1.2.3 How to Add a New Result Window

Each type of evaluation is displayed in a separate window. Up to 16 individual windows can be displayed per measurement channel (i.e. per tab).

1. Activate SmartGrid mode.

   All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar.

2. Select the icon for the required evaluation method from the evaluation bar.
   If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. Touch the evaluation bar between the icons and move it up or down until the required icon appears.

3. Drag the required icon from the evaluation bar to the SmartGrid, which is displayed in the diagram area, and drop it at the required position. (See chapter 4.5.2.5, "How to Arrange the Result Windows", on page 74 for more information on positioning the window).

Remote command:

LAYout:ADD[:WINDow]? on page 333 / LAYout:WINDow<n>:ADD? on page 337

8.1.2.4 How to Close a Result Window

► To close a window, activate SmartGrid mode and select the "Delete" icon for the window.

Remote command:

LAYout:REMove[:WINDow] on page 335 / LAYout:WINDow<n>:REMove on page 338

8.1.2.5 How to Arrange the Result Windows

1. Select an icon from the evaluation bar or the "Move" icon for an existing evaluation window.

2. Drag the evaluation over the SmartGrid.
   A blue area shows where the window will be placed.
3. Move the window until a suitable area is indicated in blue.
4. Drop the window in the target area.

   The windows are rearranged to the selected layout, and "Delete" and "Move" icons are displayed in each window.
5. To close a window, select the corresponding "Delete" icon.

Remote command:

LAYout:REPLace[:WINDow] on page 335 / LAYout:WINDow<n>:REPLace on page 338

8.2 Zoomed Displays

You can zoom into the diagram to visualize the measurement results in greater detail. Using the touchscreen or a mouse pointer you can easily define the area to be enlarged.

- Single Zoom Versus Multiple Zoom 125
- Zoom Functions 126
- How to Zoom Into a Diagram 127

8.2.1 Single Zoom Versus Multiple Zoom

Two different (graphical) zoom modes are available: single zoom and multiple zoom. A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible. In multiple zoom mode, you can enlarge up to four different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom areas can be moved and resized any time. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Fig. 8-3: Single zoom

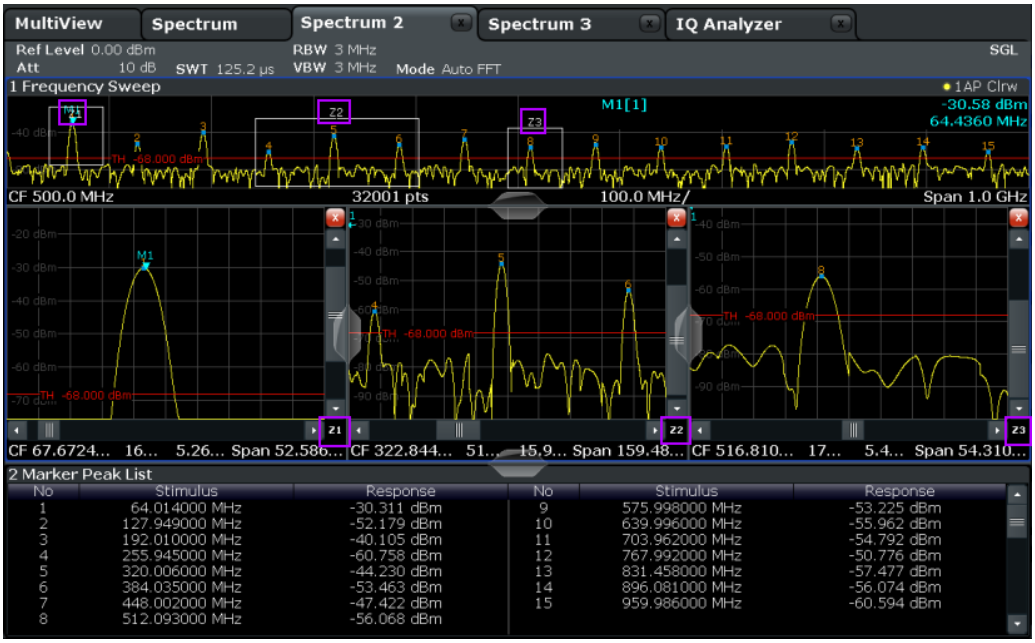


Fig. 8-4: Multiple zoom

8.2.2 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom 126
Multiple Zoom 126
Restore Original Display 127
Deactivating Zoom (Selection mode) 127

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 340

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 338

Multiple Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 340
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 339

Restore Original Display

Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 340

Deactivating Zoom (Selection mode)
Deactivates any zoom mode.

Tapping the screen no longer invokes a zoom, but selects an object.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 340

8.2.3 How to Zoom Into a Diagram

The remote commands required to zoom into a display are described in chapter 12.7.2, "Zoom", on page 338.

The following tasks are described here:

- "To zoom into the diagram at one position" on page 127
- "To return to selection mode in the diagram" on page 128
- "To return to original display" on page 128
- "To zoom into multiple positions in the diagram" on page 128

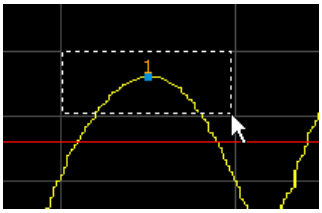
To zoom into the diagram at one position

1.

   Click on the "Single Zoom" icon in the toolbar.

   Zoom mode is activated.

2. Select the area in the diagram to be enlarged on the touchscreen. The selected area is indicated by a dotted rectangle.

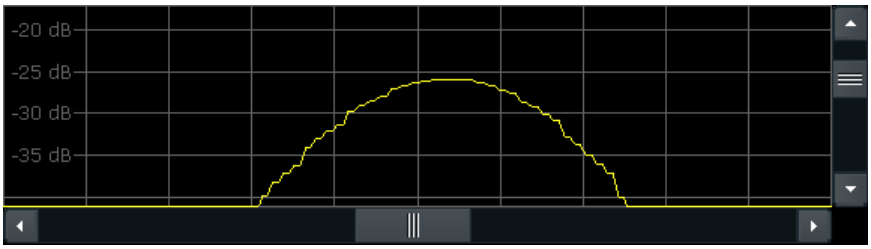


When you leave the touchscreen, the diagram is replaced by the zoomed trace area.

3. Repeat these steps, if necessary, to enlarge the diagram further.

Scrolling in the zoomed display

You can scroll the diagram area to display the entire diagram using the scrollbars at the right and at the bottom of the diagram.



To return to selection mode in the diagram

While you are in zoom mode, touching the screen changes the zoom area. In order to select or move a trace or marker, you must switch back to selection mode:

▶

Select the "Selection mode" icon in the toolbar.

To return to original display

▶

Click on the "Zoom Off" icon in the toolbar.

The original trace display is restored. Zoom mode remains active, however.
To switch off zoom mode and return to selection mode, select the "Selection mode" icon in the toolbar.

To zoom into multiple positions in the diagram

1.

Click on the "Multiple Zoom" icon in the toolbar.

Multiple zoom mode is activated.

2. Select the first area in the diagram to be enlarged as described in "To zoom into the diagram at one position" on page 127. The selected area is indicated by a dotted rectangle.

   When you have completed your selection, the original trace is shown in an overview diagram with the selected area indicated by a dotted rectangle. The zoomed trace area is displayed in a separate window (see figure 8-4.

3. In the overview diagram, select the next area to be enlarged.

   The second zoom area is indicated in the overview diagram, and a second zoom window is displayed.

4. Repeat these steps, if necessary, to zoom into further trace areas (up to four).

To move or change zoom areas

In multiple zoom mode, you can change the size or position of the individual zoom areas easily at any time.

1. If necessary, switch off zoom mode and return to selection mode by selecting the "Selection mode" icon in the toolbar.
2. To resize a zoom area, tap directly **on** the corresponding frame in the overview window and drag the line to change the size of the frame.
   To move a zoom area, tap **inside** the corresponding frame in the overview window and drag the frame to the new position.

   The contents of the zoom windows are adapted accordingly.

8.3 Trace Configuration

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- Spurs and Spur Removal....132
- Trace Configuration....133
- Trace / Data Export Configuration....135
- Trace Math....136
- Trace Labels....137
- How to Copy Traces....137

8.3.1 Analyzing Several Traces - Trace Mode

If several measurement are performed one after the other, or continuous measurement are performed, the trace mode determines how the data for subsequent traces is processed. After each measurement, the trace mode determines whether:

- the data is frozen (View)
- the data is hidden (Blank)
- the data is replaced by new values (Clear Write)

- the data is replaced selectively (Max Hold, Min Hold, Average)

Each time the trace mode is changed, the selected trace memory is cleared.

The R&S FSWP supports the following trace modes:

Table 8-1: Overview of available trace modes

Trace Mode	Description
Blank	Hides the selected trace.
Clear Write	Overwrite mode: the trace is overwritten by each measurement. This is the default setting. All available detectors can be selected.
Max Hold	The maximum value is determined over several measurements and displayed. The R&S FSWP saves the measurement result in the trace memory only if the new value is greater than the previous one.
Min Hold	The minimum value is determined from several measurements and displayed. The R&S FSWP saves the measurement result in the trace memory only if the new value is lower than the previous one.
Average	The average is formed over several measurements and displayed. The Sweep / Average Count determines the number of averaging procedures.
View	The current contents of the trace memory are frozen and displayed.
Write Hold	The trace is overwritten when new data is available, but only after all cross-correlation operations defined for a half decade are done.

If a trace is frozen ("View" mode), the measurement settings, apart from scaling settings, can be changed without impact on the displayed trace. The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk on the tab label.

If you change any parameters that have an effect on the scaling of the diagram axes, the R&S FSWP automatically adapts the trace data to the changed display range. This allows you to zoom into the diagram after the measurement in order to show details of the trace.

8.3.2 Trace Averaging

The application provides several modes of trace averaging that you can use separately or in any combination.

The order in which averaging is performed is as follows. For more details for each averaging mode see below.

1. Cross-correlation

The application performs a certain number of cross-correlation operations in each half decade.

2. Sweep Count.
   The application measures the complete measurement range a particular number of times.
   It again includes the cross-correlation operations as defined.

   After the measurement over the sweep count is finished, the application displays the averaged results.

3. Trace smoothing.
   Calculates the moving average for the current trace.

8.3.2.1 Sweep Count

The sweep count defines the number of sweeps that the application performs during a complete measurements.

A sweep in this context is the measurement over the complete measurement range once. A complete measurement, however, can consists of more than one sweep. In that case the application measures until the number of sweeps that have been defined are done. The measurement configuration stays the same all the time.

In combination with the Average trace mode and cross-correlation operations, the sweep count averages the trace even more.

8.3.2.2 Trace Smoothing

(Software-based) **smoothing** is a way to visually remove anomalies in the trace that may distort the results. The smoothing process is based on a moving average over the complete measurement range. The number of samples included in the averaging process (the *aperture* size) is variable and is a percentage of all samples that the trace consists of.

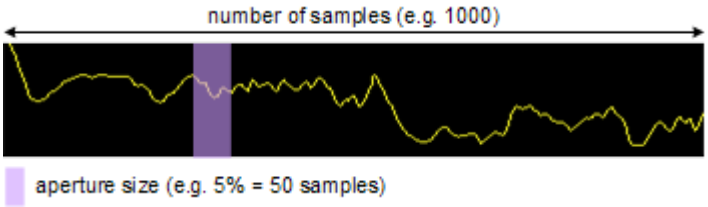


Fig. 8-5: Sample size included in trace smoothing

The application smoothes the trace continuously. Smoothing is really just an enhancement of the trace display, not of the data itself. It is always applied after any other trace averagings have been done.

You can turn trace smoothing on and off for all traces individually and compare, for example, the raw and the smooth trace.

The **median** trace smooting uses a median filter which takes the median value over a sliding window. The window size can be set in the trace menu in percent of the total

evaluation range. A median filter suppresses outliers while smoothing the underlying noise curve.

8.3.3 Spurs and Spur Removal

Most phase noise results contain spurs. Spurs are peak levels at one or more offset frequencies and are caused mostly by interfering signals. For some applications you may want to specifically indentify the location of spurs. However, for some applications, spurs do not matter in evaluating the results and you may want to remove them from the trace in order to get a "smooth" phase noise trace.

Spur removal

The application allows you to (visually) remove spurs from the trace. Spur removal is based on an algorithm that detects and completely removes the spurs from the trace and fills the gaps with data that has been determined mathematically.

The spur removal functionality separates the actual spur power from the underlying phase noise and displays the latter in a two-stage process. The first stage of spur detection is based on an eigenvalue decomposition during the signal processing.

Spur threshold

During the second stage, the application uses statistical methods to remove a spur. A spur is detected, if the level of the signal is above a certain threshold. The spur threshold is relative to an imaginary median trace that the application calculates.

If parts of the signal are identfied as spurs, the application removes all signal parts above that level and substitutes them with the median trace.

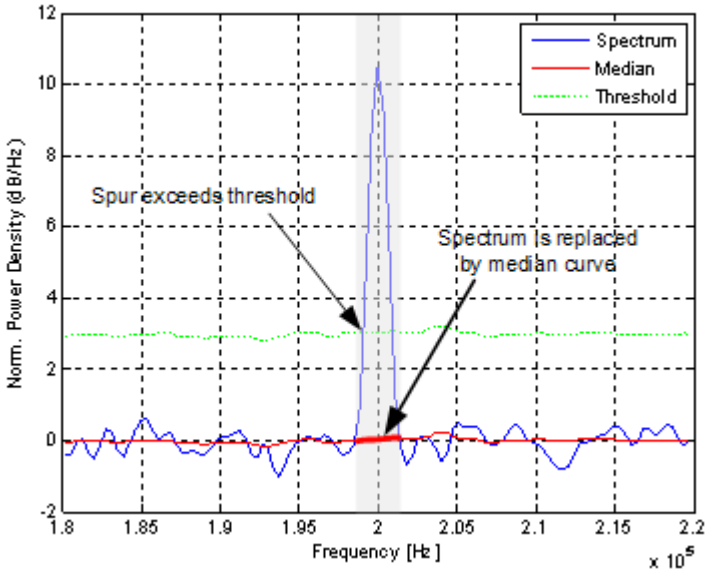


Fig. 8-6: Spur detection and removal principle

8.3.4 Trace Configuration

Traces are the graphical representation of the measurement results. Depending on the trace configuration, they carry different information or evaluate the results differently.

Access to trace settings

► "Overview" > "Analysis" > "Traces" > "Traces"

Restoring default traces

The application allows you to easily restore the default trace configuration (Trace 1 and 2 with their respective default characteristics) with the "Preset all Traces" button.

Displaying all result types

Similarily, you can easily display all available result type (PM, AM and overall noise) with the "Set Result Type" button. When you do so, the application displays three traces in the diagram, one for the phase noise, one for the AM noise and the third showing the sum of the phase noise and AM noise (PN + AM).

Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6
Selects the corresponding trace for configuration. The currently selected trace is highlighted.

Remote command:
Selected via numeric suffix of:`TRACe<1...6>` commands

Trace Mode
Defines the update mode for subsequent traces.

For details see chapter 8.3.1, "Analyzing Several Traces - Trace Mode", on page 129.

"Clear Write"	Overwrite mode: the trace is overwritten by each measurement. This is the default setting.
"Max Hold"	The maximum value is determined over several measurements and displayed. The R&S FSWP saves each trace point in the trace memory only if the new value is greater than the previous one.
"Min Hold"	The minimum value is determined from several measurements and displayed. The R&S FSWP saves each trace point in the trace memory only if the new value is lower than the previous one.
"Average"	The average is formed over several measurements.
"View"	The current contents of the trace memory are frozen and displayed.
"Blank"	Removes the selected trace from the display.

"Write Hold" The trace is overwritten when new data is available, but only after all cross-correlation operations defined for a half decade are done (or when the trace cannot improved further when XCORR Optimazation is on).
Example: 100 cross-correlation operations are defined for a half decade. The trace is updated when all 100 cross-correlations are done, not after each individual cross-correlation operation.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 341

Selecting the displayed result
The R&S FSWP supports several noise characteristics that you can assign to a trace and thus display in the diagram.

- "Phase Noise"
  Shows the measured phase noise characteristics.
- "AM Noise"
  Shows the measured amplitude noise characteristics.
- "Phase + AM Noise"
  Shows the sum of the phase noise and AM noise characteristics.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:RESult[:TYPE]` on page 342

Smoothing traces
The R&S FSWP allows you to smooth traces and thus remove unwanted anomalies.

You can apply smoothing to all active traces individually (Smoothing "State"), and define the magnitude of trace smoothing in percent (Smoothing "Value").

The range is from 1% to 20%.

More information.

Remote command:
State: `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]` on page 344
Value: `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture` on page 343

Removing spurs
Spur removal is a method to visually remove displayed peak levels, if required.

You can apply spur removal to all active traces individually (Spurious Removal "State"), and define a threshold (in dB) that defines when a peak level is recognized as a spur (Spurious Removal "Value").

More information

Remote command:
State: `DISPlay[:WINDow<n>]:TRACe<t>:SPURs:SUPPress` on page 344
Value: `DISPlay[:WINDow<n>]:TRACe<t>:SPURs:THReshold` on page 344

Shifting the trace
Shifting the trace may be useful to subtract external noise sources from the results. The trace offset is a visual device that shifts the trace by certain level.

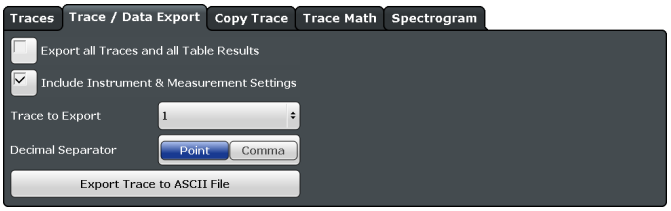
You can apply an offset to all active traces individually (Offset "State"), and define an offset in dB by which the trace should be shifted.

Remote command:
State: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet:STATe` on page 343
Offset: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 343

8.3.5 Trace / Data Export Configuration

Access: "Overview" > "Analysis" > "Traces" > "Trace/Data Export"

The standard data management functions (e.g. saving or loading instrument settings) that are available for all R&S FSWP applications are not described here.



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Decimal Separator....136
Export Trace to ASCII File....136

Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. Result Summary, marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`FORMat:DEXPort:TRACes` on page 347

Include Instrument Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 346

Trace to Export
Defines an individual trace that will be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 346

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 393

8.3.6 Trace Math

Access to trace mathematics

► "Overview" > "Analysis" > "Traces" > "Trace Math"

Selecting the math operation 136

Selecting the math operation
You can select one of several different math operations that should be applied.

Each operation subtracts one trace from another as indicated on the corresponding button and writes the result to one of the traces. "T1 - T3 > T1", for example, subtracts trace 3 from trace 1 and writes the result to trace 1. You can apply one operation at a time.

To turn off trace mathematics, use the "Trace Math Off" feature.

Remote command:
Operation: `CALCulate<n>:MATH[:EXPRession][:DEFine]` on page 348
State: `CALCulate<n>:MATH:STATe` on page 347

8.3.7 Trace Labels

Trace labels are a way to assign a descriptive label to traces instead of the general "Trace <x>" label (default). The labels you use are arbitrary and are displayed in the diagram area. The font color corresponds to the color of the respective trace (for example yellow trace: yellow font).

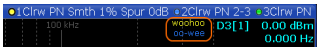


Fig. 8-7: Example: the yellow and blue trace have a label.

You can define trace labels in the "Trace Label" tab of the "Trace" dialog box.

To assign trace labels

Trace labels can be configured via the "Trace Labels" dialog box.

To display the "Trace Labels" dialog box, do one of the following:

1. Select "Analysis" from the "Overview" dialog box, then the "Traces" tab followed by the "Trace Labels" tab.
2. Press the TRACE key, then the "Trace Config" softkey and select the "Trace Labels" tab.
3. Turn on the trace label for a specific trace and assign a label in the corresponding input field.
   Note that a trace must be active. Otherwise assigning a label is not possible.
4. Move the trace label to any position on the display by dragging it to the new position.

Remote command:

State: `DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe]` on page 342

Label: `DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT` on page 342

8.3.8 How to Copy Traces

You can copy the trace settings from one trace to another in the "Copy Trace" tab of the "Traces" dialog box.

► Select the "Source" trace and then the button for the "Copy to" trace.

Remote command:

`TRACe<n>:COPY` on page 345

8.4 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

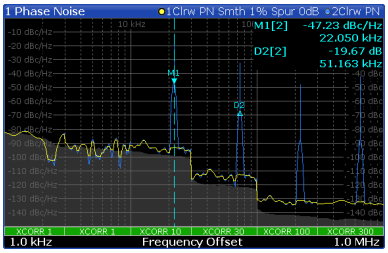
- Basics on Markers and Marker Functions 138
- Marker Settings 140
- Marker Search Settings and Positioning Functions 143

8.4.1 Basics on Markers and Marker Functions

Some background knowledge on marker settings and functions is provided here for a better understanding of the required configuration settings.

Markers are used to mark points on traces, to read out measurement results and to select a display section quickly. R&S FSWP provides 16 markers per display window. In the Phase Noise application, markers across measurement windows are independent from each other - thus you can move a marker in one window without moving it in another window.

- The easiest way to work with markers is using the touch screen. Simply drag the marker and drop it at the required position. When a marker label is selected, a vertical line is displayed which indicates the marker's current x-value.



- Alternatively, change the position of the selected marker using the rotary knob. By default, the marker is moved from one pixel to the next.
- You can also set an active marker to a new position by defining its x-position numerically. When you select the softkey for a marker, an edit dialog box is displayed.
- The most commonly required marker settings and functions are also available as softkeys or via the context menu. Tap the marker on the touch screen and hold your finger for about 2 seconds until the context menu is opened, then select the required entry.
- Softkeys for active markers (displayed on the screen) are highlighted blue. The softkey for the currently selected marker (for which functions are performed) is highlighted orange.
- To set individual markers very quickly, use the softkeys in the "Marker" menu.
- To set up several markers at once, use the "Marker" dialog box.
- To position the selected marker to a special value, use the softkeys in the "Marker To" menu.

Marker types

All markers can be used either as normal markers or delta markers. A normal marker indicates the absolute signal value at the defined position in the diagram. A delta marker indicates the value of the marker relative to the specified reference marker (by default marker 1).

- Activating Markers....139
- Marker Results....139

8.4.1.1 Activating Markers

Only active markers are displayed in the diagram and in the marker table.

Active markers are indicated by a highlighted softkey.

By default, marker 1 is active and positioned on the maximum value (peak) of trace 1 as a normal marker. If several traces are displayed, the marker is set to the maximum value of the trace which has the lowest number and is not frozen (View mode). The next marker to be activated is set to the frequency of the next lower level (next peak) as a delta marker; its value is indicated as an offset to marker 1.

A marker can only be activated when at least one trace in the corresponding window is visible. If a trace is switched off, the corresponding markers and marker functions are also deactivated. If the trace is switched on again, the markers along with coupled functions are restored to their original positions, provided the markers have not been used on another trace.

8.4.1.2 Marker Results

Normal markers point to a trace point on the x-axis and display the associated numeric value for that trace point. Delta markers indicate an offset between the level at the delta marker position and the level at the position of the assigned reference marker, in dB.

The results can be displayed directly within the diagram area or in a separate table. By default, the first two active markers are displayed in the diagram area. If more markers are activated, the results are displayed in a marker table.

Marker information in diagram area

By default, the results of the last two markers or delta markers that were activated are displayed in the diagram area.

The following information is displayed there:

- The marker type (M for normal, D for delta, or special function name)
- The marker number (1 to 16)

- The assigned trace number in square brackets [ ]
- The marker value on the y-axis, or the result of the marker function
- The marker position on the x-axis

Marker information in marker table

In addition to the marker information displayed within the diagram area, a separate marker table may be displayed beneath the diagram. This table provides the following information for all active markers:

Table 8-2: Contents of the marker table in the Phase Noise application

Window	Window the marker is in (only if you have opened more than one Phase Noise diagram)
Type	Marker type: N (normal), D (delta), T (temporary, internal) and number
Ref	Reference marker for delta markers
Trc	Trace to which the marker is assigned
X-value	X-value of the marker
Y-value	Y-value of the marker

8.4.2 Marker Settings

For more information about marker search see chapter 8.4.3, "Marker Search Settings and Positioning Functions", on page 143

- Individual Marker Setup 140
- General Marker Settings 142

8.4.2.1 Individual Marker Setup

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.

The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

Access to individual marker settings

► "Overview" > "Analysis" > "Markers" > "Markers"

The remote commands required to define these settings are described in chapter 12.7.4, "Marker", on page 349.

Selected Marker 141
Marker State 141
Marker Position (X-value) 141
Marker Type 141

Reference Marker 141
Linking to Another Marker 142
Assigning the Marker to a Trace 142
Select Marker 142
All Markers Off 142

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 352
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

Marker Position (X-value)
Defines the position (x-value) of the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>:X` on page 352
`CALCulate<n>:DELTamarker<m>:X` on page 351

Marker Type
Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 352
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 350

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

If the reference marker is deactivated, the delta marker referring to it is also deactivated.

Remote command:
`CALCulate<n>:DELTamarker<m>:MREF` on page 350

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the inital marker is changed, the linked marker follows on the same x-position. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
`CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m>` on page 352
`CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m>` on page 350
`CALCulate<n>:DELTamarker<m>:LINK` on page 349

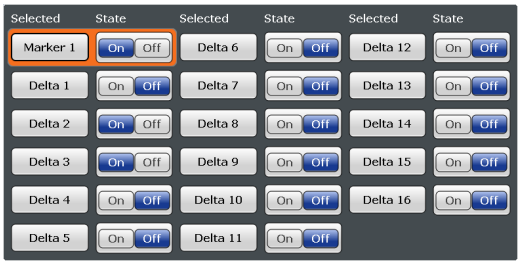
Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

The marker can also be assigned to the currently active trace using the "Marker to Trace" softkey in the "Marker" menu.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
`CALCulate<n>:MARKer<m>:TRACe` on page 352

Select Marker
The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.



Remote command:
Marker selected via suffix <m> in remote commands.

All Markers Off
Deactivates all markers in one step.

Remote command:
`CALCulate<n>:MARKer<m>:AOFF` on page 351

8.4.2.2 General Marker Settings

Some general marker settings allow you to influence the marker behavior for all markers.

Access to general marker settings

► "Overview" > "Analysis" > "Markers" > "Settings"

The remote commands required to define these settings are described in chapter 12.7.4, "Marker", on page 349.

Marker Table Display..... 143
Linked Markers..... 143

Marker Table Display
Defines how the marker information is displayed.

"On" Displays the marker information in a table in a separate area beneath the diagram.

"Off" Displays the marker information within the diagram area.

Remote command:
`DISPlay:MTABle` on page 353

Linked Markers
If enabled, the markers in all diagrams with the same x-axis are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 353

8.4.3 Marker Search Settings and Positioning Functions

Several functions are available to set the marker to a specific position very quickly and easily, or to use the current marker position to define another characteristic value. In order to determine the required marker position, searches may be performed. The search results can be influenced by special settings.

Most marker positioning functions and the search settings are available in the MKR → menu.

Search settings are also available via the MARKER key or in the vertical "Marker Config" tab of the "Analysis" dialog box (horizontal "Search Settings" tab).

The remote commands required to define these settings are described in chapter 12.7.4.3, "Marker Search", on page 353 and chapter 12.7.4.4, "Positioning Markers", on page 354.

- Marker Search Settings..... 143
- Positioning Functions..... 144

8.4.3.1 Marker Search Settings

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.

Access to marker search settings

► "Overview" > "Analysis" > "Markers" > "Search"

Search Mode for Next Peak 144
Peak Excursion 144

Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
Find a list of remote commands in chapter 12.7.4.4, "Positioning Markers", on page 354.

Peak Excursion
Defines the minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the search functions.

Entries from 0 dB to 60 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 1 dB.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 354

8.4.3.2 Positioning Functions

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

Access to marker positioning functions

► MKR →

Peak Search 144
Search Next Peak 145
Search Minimum 145
Search Next Minimum 145

Peak Search
Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 356
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 355

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 356
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 356
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 356
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 354
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 355
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 354

Search Minimum
Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MINimum[:PEAK] on page 357
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 355

Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 357
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 357
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 357
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 355
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 355
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 355

8.5 Limit Lines

Limit lines help you analyze a measurement trace.

- Basics on Limit Lines 145
- Limit Line Settings and Functions 149
- Defining Limit Lines 153

8.5.1 Basics on Limit Lines

Limit lines are used to define amplitude curves or spectral distribution boundaries in the result diagram which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). When transmitting information in TDMA systems (e.g. GSM), the amplitude of the bursts in a time slot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then,

the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The R&S FSWP supports limit lines with a maximum of 200 data points. Eight of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the instrument is only limited by the capacity of the storage device used.

Compatibility

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.
- The y unit of the limit line has to be identical to the current setting.

Validity

Only limit lines that fulfill the following conditions can be activated:

- Each limit line must consist of a minimum of 2 and a maximum of 200 data points.
- The frequencies/times for each data point must be defined in ascending order; however, for any single frequency or time, two data points may be entered (to define a vertical segment of a limit line).
- Gaps in frequency or time are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies or times need not necessarily be selectable in R&S FSWP. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is -1000 s to +1000 s.

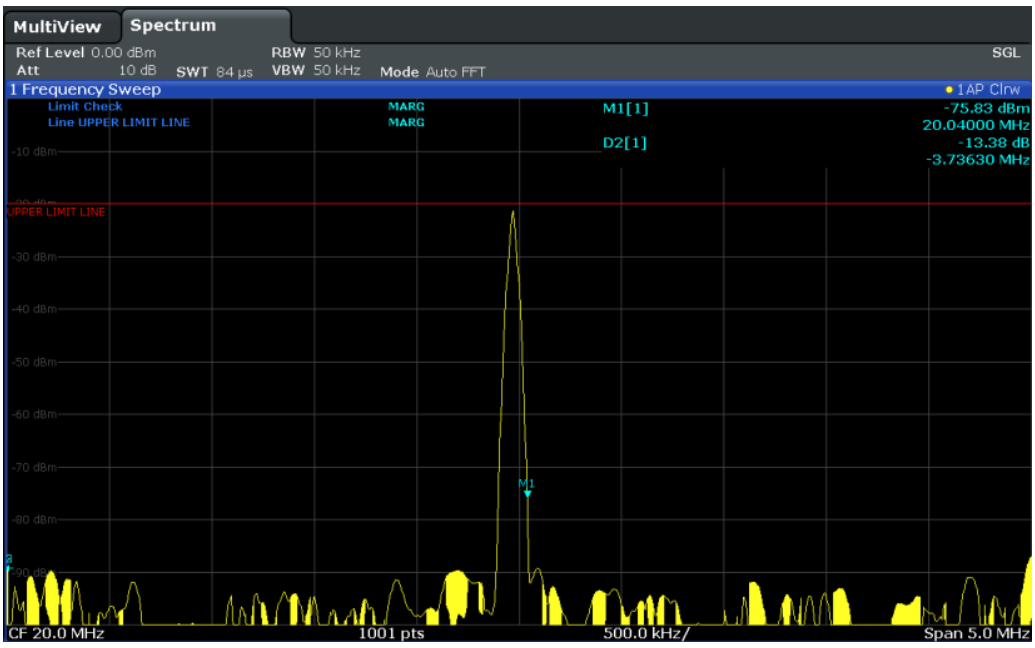
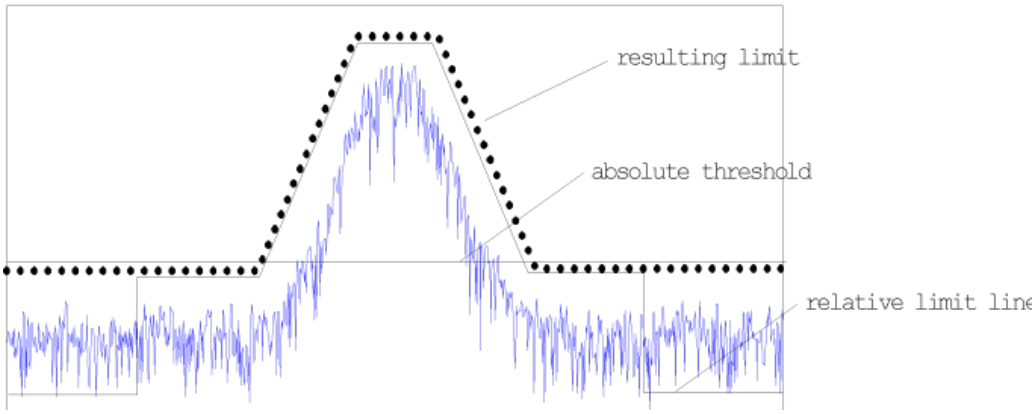


Fig. 8-8: Example for an upper limit line

Thresholds

If the y-axis for the limit line data points uses relative scaling, an additional absolute **threshold** can be defined for the limit check. In this case, both the threshold value and the relative limit line must be exceeded before a violation occurs.



Offsets and Shifting

A configured limit line can easily be moved vertically or horizontally. Two different methods to do so are available:

- An **offset** moves the entire line in the diagram without editing the configured values or positions of the individual data points. This option is only available if relative scaling is used.
  Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally or vertically.
- Defining a **shift** width for the values or position of the individual data points changes the line configuration, thus changing the position of the line in the diagram.

Limit Check Results

A limit check is automatically performed as soon as any of the limit lines is activated ("Visibility" setting). Only the specified "Traces to be Checked" are compared with the active limit lines. The status of the limit check for each limit line is indicated in the diagram. If a violation occurs, the limit check status is set to "MARG" for a margin violation, or to"FAIL" for a limit violation.

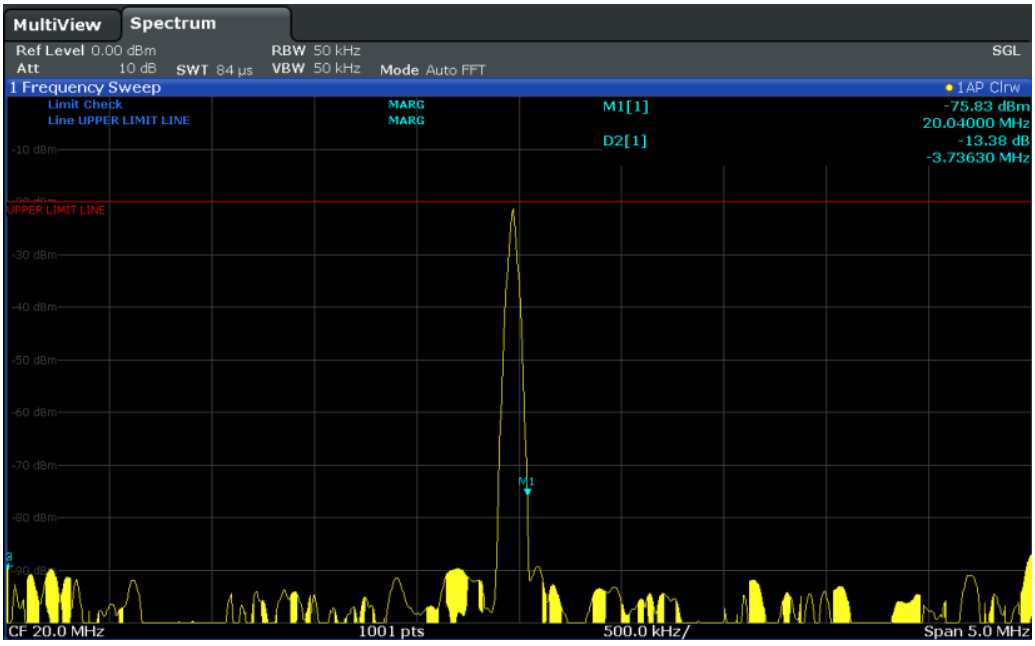


Fig. 8-9: Margin violation for limit check

Fig. 8-10: Limit violation for limit check

Storing and Recalling Limit Lines

Limit lines can be stored with the configuration settings so they can be recalled for other measurements at a later time (see chapter 9.3, "Storing and Recalling Instrument Settings and Measurement Data", on page 159). Note, however, that any changes made to the limit lines *after* storing the configuration file cannot be restored and will be overwritten by the stored values when the configuration file is recalled. Always remember to store the settings again after changing the limit line values.

After recalling measurement settings, the limit line values applied to the measurement may be different to those displayed in the "Limit Lines" dialog box; see "Saving and recalling transducer and limit line settings" on page 160.

8.5.2 Limit Line Settings and Functions

Access: "Overview" > "Analysis" > "Lines"

Up to 8 limit lines can be displayed simultaneously in the R&S FSWP. Many more can be stored on the instrument.

Stored limit line settings

When storing and recalling limit line settings, consider the information provided in the Data Management chapter of the R&S FSWP User Manual.

When storing and recalling limit line settings, consider the information provided in "Saving and recalling transducer and limit line settings" on page 160.

- Limit Line Management....149
- Limit Line Details....151

8.5.2.1 Limit Line Management

Access to limit line settings

► "Overview" > "Analysis" > "Limit Lines"

For the limit line overview, the R&S FSWP searches for all stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. The overview allows you to determine which limit lines are available and can be used for the current measurement.

For details on settings for individual lines see chapter 8.5.2.2, "Limit Line Details", on page 151.

For more basic information on limit lines see chapter 8.5.1, "Basics on Limit Lines", on page 145.

Name....150
Unit....150
Compatibility....150

Visibility 150
Traces to be Checked 150
Comment 150
Included Lines in Overview (View Filter) 150
Create New Line 151
Edit Line 151
Copy Line 151
Delete Line 151
Disable All Lines 151

Name
The name of the stored limit line.

Unit
The unit in which the y-values of the data points of the limit line are defined.

Compatibility
Indicates whether the limit line definition is compatible with the current measurement settings.

For more information on which conditions a limit line must fulfill to be compatible, see "Compatibility" on page 146.

Visibility
Displays or hides the limit line in the diagram. Up to 8 limit lines can be visible at the same time. Inactive limit lines can also be displayed in the diagram.

Remote command:
`CALCulate<n>:LIMit<k>:LOWer:STATe` on page 361
`CALCulate<n>:LIMit<k>:UPPer:STATe` on page 362
`CALCulate<n>:LIMit<k>:ACTive?` on page 360

Traces to be Checked
Defines which traces are automatically checked for conformance with the limit lines. As soon as a trace to be checked is defined, the assigned limit line is active. One limit line can be activated for several traces simultaneously. If any of the "Traces to be Checked" violate any of the active limit lines, a message is indicated in the diagram.

Remote command:
`CALCulate<n>:LIMit<k>:TRACe<t>:CHECk` on page 362

Comment
An optional description of the limit line.

Included Lines in Overview (View Filter)
Defines which of the stored lines are included in the overview.

"Show compatible"	Only compatible lines Whether a line is compatible or not is indicated in the Compatibility setting.

"Show all" All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder (if not restricted by "Show lines for all modes" setting).

Create New Line
Creates a new limit line.

Edit Line
Edit an existing limit line configuration.

Copy Line
Copy the selected limit line configuration to create a new line.

Remote command:
`CALCulate<n>:LIMit<k>:COPY` on page 360

Delete Line
Delete the selected limit line configuration.

Remote command:
`CALCulate<n>:LIMit<k>:DELete` on page 360

Disable All Lines
Disable all limit lines in one step.

Remote command:
`CALCulate<n>:LIMit<k>:STATe` on page 361

8.5.2.2 Limit Line Details

Access to limit line design

► "Overview" > "Analysis" > "Limit Lines" > "New" / "Edit" / "Copy To"

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Comment....152
X-Axis....152
Y-Axis....152
Data points....152
Insert Value....152
Delete Value....152
Shift x....152
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Name
Defines the limit line name. All names must be compatible with Windows conventions for file names. The limit line data is stored under this name (with a `.LIN` extension).

Remote command:
`CALCulate<n>:LIMit<k>:NAME` on page 366

Comment
Defines an optional comment for the limit line. The text may contain up to 40 characters.

Remote command:
CALCulate<n>:LIMit<k>:COMMent on page 363

X-Axis
Describes the horizontal axis on which the data points of the limit line are defined.

The x-axis characteristics in the Phase Noise application are always the same.

- The unit is "Hz".
- The values are "Absolute" ones.
- The scale is a "Logarithmic" one.

Remote command:
Not supported

Y-Axis
Describes the vertical axis on which the data points of the limit line are defined. Includes the following settings:

- Level unit
- The values are always "Absolute" ones.
- Limit type: upper or lower limit; values must stay above the lower limit and below the upper limit to pass the limit check

Remote command:
CALCulate<n>:LIMit<k>:UNIT on page 367
CALCulate<n>:LIMit<k>:LOWer:SPACing on page 366
CALCulate<n>:LIMit<k>:UPPer:SPACing on page 368

Data points
Each limit line is defined by a minimum of 2 and a maximum of 200 data points. Each data point is defined by its position (x-axis) and value (y-value). Data points must be defined in ascending order. The same position can have two different values.

Remote command:
CALCulate<n>:LIMit<k>:CONTrol[:DATA] on page 363
CALCulate<n>:LIMit<k>:LOWer[:DATA] on page 365
CALCulate<n>:LIMit<k>:UPPer[:DATA] on page 367

Insert Value
Inserts a data point in the limit line above the selected one in the "Edit Limit Line" dialog box.

Delete Value
Deletes the selected data point in the "Edit Limit Line" dialog box.

Shift x
Shifts the x-value of each data point horizontally by the defined shift width.

Remote command:
CALCulate<n>:LIMit<k>:CONTrol:SHIFt on page 364

Shift y
Shifts the y-value of each data point vertically by the defined shift width.

Remote command:
`CALCulate<n>:LIMit<k>:LOWer:SHIFt` on page 366
`CALCulate<n>:LIMit<k>:UPPer:SHIFt` on page 368

Save
Saves the currently edited limit line under the name defined in the "Name" field.

8.5.3 Defining Limit Lines

Limit lines are configured in the "Lines Config" dialog box. To display this dialog box, do one of the following:

- Press the LINES key and then the "Lines Config" softkey, then select the "Lines Config" tab.
- In the "Overview", select "Analysis" and then the vertical "Limit Lines Config" tab.

The following tasks are described here:

- "How to find compatible limit lines" on page 153
- "How to activate and deactivate a limit check" on page 153
- "How to edit existing limit lines" on page 154
- "How to copy an existing limit line" on page 154
- "How to delete an existing limit line" on page 154
- "How to configure a new limit line" on page 154
- "How to move the limit line vertically or horizontally" on page 155

How to find compatible limit lines

► In the "Line Config" dialog box, select the "View filter" option: "Show compatible".

All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder of the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a limit check

A limit check is automatically performed as soon as any of the limit lines is activated.

1. To activate a limit check:
   Select the "Check Traces" setting for a limit line in the overview and select the trace numbers to be included in the limit check. One limit line can be assigned to several traces.

   The specified traces to be checked are compared with the active limit lines. The status of the limit check is indicated in the diagram.

2. To deactivate a limit line, deactivate all "Traces to check" for it.
   To deactivate all limit lines at once, select the "Disable All Lines" button.

The limit checks for the deactivated limit lines are stopped and the results are removed form the display.

How to edit existing limit lines

Existing limit line configurations can be edited.

1. In the "Line Config" dialog box, select the limit line.
2. Select the "Edit" button.
3. Edit the line configuration as described in "How to configure a new limit line" on page 154.
4. Save the new configuration by selecting the "Save" button.

   If the limit line is active, the edited limit line is displayed in the diagram.

How to copy an existing limit line

1. In the "Line Config" dialog box, select the limit line.
2. Select the "Copy To" button.
3. Define a new name to create a new limit with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new limit line" on page 154.
5. Save the new configuration by selecting the "Save" button.

   The new limit line is displayed in the overview and can be activated.

How to delete an existing limit line

1. In the "Line Config" dialog box, select the limit line.
2. Select the "Delete" button.
3. Confirm the message.

   The limit line and the results of the limit check are deleted.

How to configure a new limit line

1. In the "Line Config" dialog box, select the "New" button.

   The "Edit Limit Line" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.
2. Define a "Name" and, optionally, a "Comment" for the new limit line.
3. Define the x-axis configuration:
   - Time domain or frequency domain
   - Absolute or relative limits
   - Linear or logarithmic scaling

4. Define the y-axis configuration:
   - Level unit
   - Absolute or relative limits
   - Upper or lower limit line
5. Define the data points: minimum 2, maximum 200:
   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.
   d) Repeat this to insert all other data points.
   To insert a data point before an existing one, select the data point and then "Insert Value".
   To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
   To delete a data point, select the entry and then "Delete Value".
6. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
   If necessary, shift the entire line vertically or horizontally by selecting the "Shift x" or "Shift y" button and defining the shift width.
7. Optionally, define a "Margin" at a fixed distance to the limit line.
   The margin must be within the valid value range and is not displayed in the diagram or preview area.
8. Optionally, if the y-axis uses relative scaling, define an absolute "Threshold" as an additional criteria for a violation.
9. Save the new configuration by selecting the "Save" button.

   The new limit line is displayed in the overview and can be activated.

How to move the limit line vertically or horizontally

A configured limit line can easily be moved vertically or horizontally. Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.

1. In the "Line Config" dialog box, select the limit line.
2. To shift the complete limit line parallel in the horizontal direction, select the "X-Offset" button and enter an offset value.
   To shift the complete limit line parallel in the vertical direction, select the "Y-Offset" button and enter an offset value.
3. To shift the individual data points of a limit line by a fixed value (all at once):
   a) Select the "Edit" button.
   b) In the "Edit Limit Line" dialog box, select the "Shift x" or "Shift y" button and define the shift width.
   c) Save the shifted data points by selecting the "Save" button.

   If activated, the limit line is shifted in the diagram.

9 Data Management

The R&S FSWP allows you to store and load instrument settings, as well as import and export measurement data for analysis at a later time. Finally, you can store or print the measurement results displayed on the screen.

General storage and import/export functions are available via the toolbar. Some special storage functions are (also) available via softkeys or dialog boxes in the corresponding menus, for example trace data export.

- Restoring the Default Instrument Configuration (Preset)..... 156
- Protecting Data Using the Secure User Mode..... 157
- Storing and Recalling Instrument Settings and Measurement Data..... 159
- Importing and Exporting Measurement Results for Evaluation..... 169
- Creating Screenshots of Current Measurement Results and Settings..... 175

9.1 Restoring the Default Instrument Configuration (Preset)

When delivered, the R&S FSWP has a default configuration. You can restore this defined initial state at any time as a known starting point for measurements. This is often recommendable as a first step in troubleshooting when unusual measurement results arise.

Factory default configuration

The factory default configuration is selected such that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.

To restore the default instrument configuration for all channels at once

► Press the PRESET key.

Alternatively to the factory default settings, you can define user-specific recall settings to be restored after a preset or reboot, see "To recall settings automatically after preset or reboot" on page 169.

After you use the PRESET function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the UNDO/REDO keys.

Remote command:

`*RST` or `SYSTem:PRESet`

To restore the default configuration for a single channel

The default measurement settings can also be reset for an individual channel only, rather than resetting the entire instrument.

► In the "Overview", select the "Preset Channel" button.

The factory default settings are restored to the current channel. Note that a user-defined recall settings file is **NOT** restored.

Remote command:

`SYSTem:PRESet:CHANnel[:EXECute]` on page 386

9.2 Protecting Data Using the Secure User Mode

During normal operation, the R&S FSWP uses a solid-state drive to store its operating system, instrument firmware, instrument self-alignment data, and any user data created during operation. If necessary, the solid-state drive can be removed from the R&S FSWP and locked in a secure place to protect any classified data it may contain.

Redirecting storage to volatile memory

Alternatively, to avoid storing any sensitive data on the R&S FSWP permanently, the *secure user mode* was introduced (option R&S FSWP-K33). In secure user mode the instrument's solid-state drive is write-protected so that no information can be written to memory permanently. Data that the R&S FSWP normally stores on the solid-state drive is redirected to volatile memory instead, which remains available only until the instrument is switched off. This data includes:

- Windows 7 operating system files
- Firmware shutdown files containing information on last instrument state
- Self-alignment data
- General instrument settings such as the IP address
- Measurement settings
- User data created during operation
  (see also table 9-1)
- Any data created by other applications installed on the R&S FSWP, for example text editors (Notepad), the Clipboard, drawing tools etc.

Data that is stored in volatile memory can be accessed by the user just as in normal operation; however, when the instrument's power is switched off, all data in this memory is cleared. Thus, in secure user mode, the instrument always starts in a defined, fixed state when switched on.

In order to store data such as measurement results permanently, it must be stored to an external storage device, such as a memory stick.

Limited storage space

The volatile memory used to store data in secure user mode is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

Storing required data permanently

Any data that is to be available for subsequent sessions with the R&S FSWP, such as predefined instrument settings, transducer factors or self-alignment data, must be stored on the instrument permanently, *prior to activating the secure user mode*.

Self-alignment data

Note that self-alignment data becomes invalid with time and due to temperature changes. Therefore, to achieve optimal accuracy, it may be preferable to perform a new self-alignment at the start of each new session on the R&S FSWP.

Restricted operation

Due to the fact that permanent storage is not possible, the following functions are not available in secure user mode:

- Firmware update
- Activating a new option key

Furthermore, since the "SecureUser" used in secure user mode does not have administrator rights, **administrative tasks** such as LAN configuration and some general instrument settings are not available. Refer to the description of the basic instrument setup (SETUP menu) to find out which functions are affected.

Activating and deactivating secure user mode

Only a user with administrator rights can activate the secure user mode. Once activated, a restart is required. The special user "SecureUser" is then logged on to the R&S FSWP automatically using the automatic login function. While the secure user mode is active, a message is displayed in the status bar at the bottom of the screen.

Secure Passwords

By default, the initial password for both the administrator account ("Instrument") and the "SecureUser" account is "894129". When the secure user mode is activated the first time after installation, you are prompted to change the passwords for all user accounts in order to improve system security. Although it is possible to continue without changing the passwords, it is strongly recommended that you do so.

You can change the password in Windows 7 for any user at any time via "Start > Control Panel > User Accounts".

In order to deactivate the secure user mode, the "SecureUser" must log off and the "Instrument" user (administrator) must log on.

Switching users when using the automatic login function

In the "Start" menu, select the arrow next to the "Shut down" button and then "Log off".

The "Login" dialog box is displayed, in which you can enter the different user account name and password.

The secure user mode setting and automatic login is automatically deactivated when the "Instrument" user logs on. The "SecureUser" is no longer available.

For administrators ("Instrument" user), the secure user mode setting is available in the general system configuration settings (see chapter 10.2.3.5, "General Configuration Settings", on page 190).

Remote control

Initially after installation of the R&S FSWP-K33 option, secure user mode must be enabled manually once before remote control is possible.

(See `SYSTem:SECurity[:STATe]`.)

This is necessary to prompt for a change of passwords.

9.3 Storing and Recalling Instrument Settings and Measurement Data

Possibly you would like to restore or repeat a measurement you performed under specific conditions on the instrument. Or you want to evaluate imported data in another application on the R&S FSWP and would like to restore the measurement settings applied during measurement. In these cases, you can store and recall instrument and measurement settings, and possibly other related measurement data.

Two different methods are available for managing instrument settings:

- Quick Save/Quick Recall - a defined set of instrument or channel settings are stored or recalled quickly in just one step
- Configurable Save/Recall - a user-defined set of instrument or channel settings are stored to a definable storage location

Restrictions when recalling measurement settings

When recalling a saved configuration file, the following restrictions apply:

- The frequency range defined in the configuration file must be supported by the R&S FSWP on which the file is to be recalled.
- Configuration files created on a R&S FSWP with certain options in use will not work on an R&S FSWP without these options
- Files created with newer firmware versions may not work with a previous version

Saving instrument settings in secure user mode

Be sure to store instrument settings that you require beyond the current session before Secure User Mode is enabled; see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Settings that are saved via QuickSave in secure user mode are only available during the current session. As soon as the power is switched off on the R&S FSWP, the data is cleared.

Saving and recalling transducer and limit line settings

If a limit lines file was in use when the save set was stored (with the save item "Current Settings" only) it is anticipated that these limit lines values should remain valid after every recall of that save set. Thus, even if the limit lines file is changed and the original save set file is recalled later, the *originally stored* limit lines values are recalled and applied to the measurement. In the "Edit limit lines" dialog box, however, the *changed* limit lines file values are displayed as no updated limit lines file was loaded.

The same applies to limit line settings.

The same applies to integrated measurements' weighting filter.

Similarly, if you want to apply the changed limit values after recalling the save set you must force the application to reload the limit file. To do so, simply open the "Edit Limit Line" dialog box (see chapter 8.5.2, "Limit Line Settings and Functions", on page 149) and toggle the "Y-Axis" unit. Due to that change, the limit line file is automatically reloaded, and the changed limit values are applied to the current measurement. Now a new save set with the updated limit values can be created.

- Quick Save/Quick Recall....160
- Configurable Storage and Recall....162
- How to Save and Load Instrument Settings....167

9.3.1 Quick Save/Quick Recall

The Quick Save and Quick Recall functions allow you to store instrument or channel settings very easily and quickly in one step. Up to 10 different sets of settings can be stored to or recalled from "save sets". Each save set is identified by its storage date and type (instrument or specific channel) in the display. The save sets are stored in the `C:\r_s\instr\user\QuickSave` directory, in files named `QuickSave1.dfl` to `QuickSave10.dfl`. The storage file names and locations cannot be changed. Only the current measurement settings are stored, not any additional data such as traces, limit line or transducer files (see chapter 9.3.2.1, "Stored Data Types", on page 162).

During recall, save sets of type "Instrument" replace the settings of the entire instrument. All other save sets start a new measurement channel with the stored settings.

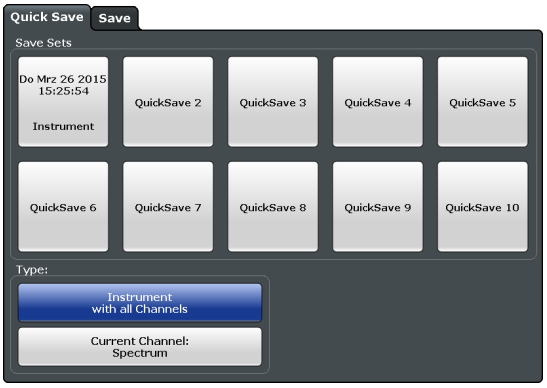
If a measurement channel with the same name as the channel to be restored is already active, the channel name for the new channel is extended by a consecutive number:

9.3.1.1 Quick Save / Quick Recall Settings

The "QuickSave" dialog box is displayed when you select the "Save" icon in the toolbar.

The "Quick Recall" dialog box is displayed when you select the "Open" icon in the toolbar, or select the "Quick Recall" tab in the "Recall" dialog box.

Both dialog boxes are very similar and closely related.



QuickSave 1 / ... / QuickSave 10 161
Storage Type (Save only) 161
Recall 162

QuickSave 1 / ... / QuickSave 10
Selects one of the save sets to store the current settings in or to be recalled. At the time of storage, the "QuickSave 1 / ... / QuickSave 10" placeholder is replaced by a label indicating the storage date and time and the storage type.

During recall, save sets of type "Instrument" replace the settings of the entire instrument. All other save sets start a new measurement channel with the stored settings.

Storage Type (Save only)
Defines which type of settings is to be stored in the save set.

"Instrument with all channels"	The instrument settings for all currently active channels are stored.
"Current Channel"	Only the instrument settings for the currently selected measurement channel are stored.

Recall
Restores the instrument settings as saved in the selected settings file. If the settings file contains settings for a specific channel only a new channel with the stored settings is activated, otherwise the entire instrument settings are loaded.

Note: After you use the "Recall" function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the UNDO/REDO keys.

Note: If a measurement channel with the same name as the channel to be restored (in a new channel) is already active, the channel name for the new channel is extended by a consecutive number:

In remote commands, you must append this number to the channel name, as well.

Remote command:
`MMEMory:LOAD:STATe` on page 383

9.3.2 Configurable Storage and Recall

The more sophisticated storage and recall functions allow you to define which settings are stored, and where the settings file is stored to. Any settings file can be selected for recall.

- Stored Data Types 162
- Storage Location and File Name 163
- Save and Recall Dialog Boxes 163
- Startup Recall Settings 166

9.3.2.1 Stored Data Types

The following types of data can be stored to and loaded from files via the "Save" dialog box on the R&S FSWP:

Table 9-1: Items that can be stored to files

Item	Description
Current Settings	Current instrument and measurement settings
All Transducers	Transducer *files* for all active transducers (Not in the Phase Noise application.)
All Traces	All active traces;
All Limit Lines	All limit line *files*
All Weighting Filters	All weighting filter *files* (Only in the Phase Noise application.)
Spectrograms	Spectrogram trace data (only available if spectrogram display is currently active) (Only in applications that feature a spectrogram, for example the (optional) Spectrum application.)

Item	Description
Noise - ENR	Data in "ENR Settings" dialog box (R&S FSWP-K30 only)
Noise - Loss Settings	Data in "Loss Settings" dialog box (R&S FSWP-K30 only)
Noise - Calibration data	Results from calibration measurement (R&S FSWP-K30 only)

9.3.2.2 Storage Location and File Name

The data is stored on the internal flash disk or, if selected, on a memory stick or network drive. The operating system, firmware and stored instrument settings are located on drive C. All other folders and drives can be used to store measurement data.

Saving instrument settings in secure user mode

In secure user mode all data is stored to the SDRAM, and is only available during the current session. As soon as the power is switched off on the R&S FSWP, the data is cleared (see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157).

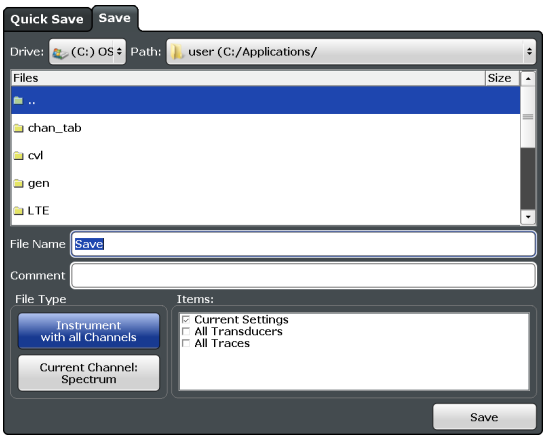
Other storage locations cannot be selected in this mode.

The storage location and file name are selected in a file selection dialog box which is displayed when you perform a storage function.

By default, the name of a settings file consists of a base name followed by an underscore and three numbers, e.g. `limit_lines_005`. In the example, the base name is `limit_lines`. The base name can contain characters, numbers and underscores. The file extension `dfl` is added automatically. The default folder for settings files is `C:\r_s\instr\user`.

9.3.2.3 Save and Recall Dialog Boxes

The following dialog boxes are available via softkeys in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar. Both dialog boxes are very similar and closely related.



Selecting the Storage Location - Drive/ Path/ Files....164
File Name....164
Comment....164
File Type....165
Items....165
Save File....165
Recall in New Channel / Recall in Current Channel....165

Selecting the Storage Location - Drive/ Path/ Files
Select the storage location of the settings file on the instrument or an external drive.

The "Drive" indicates the internal (C:) or any connected external drives (e.g. a USB storage device).

The "Path" contains the drive and the complete file path to the currently selected folder.

The "Files" list contains all subfolders and files of the currently selected path.

Note: Saving instrument settings in secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Remote command:
`MMEMory:CATalog?` on page 374

File Name
Contains the name of the data file without the path or extension.

By default, the name of a settings file consists of a base name followed by an underscore. Multiple files with the same base name are extended by three numbers, e.g. `limit_lines_005`.

For details on the file name and location see chapter 9.3.2.2, "Storage Location and File Name", on page 163.

Note: Saving instrument settings in secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Comment
An optional description for the data file. A maximum of 60 characters can be displayed.

Remote command:
`MMEMory:COMMent` on page 375

File Type
Determines whether the global instrument settings with all channels will be stored or recalled, or the current channel settings only.

Items
Defines which data and settings are stored or will be recalled. Depending on the "File Type", only channel settings or global settings are available. Which items are available also depends on the installed options (see also chapter 9.3.2.1, "Stored Data Types", on page 162).

Depending on the application, items may or may not be available. For example, saving spectrogram data is only possible in applications that feature a spectrogram.

Remote command:
`MMEMory:SELect[:ITEM]:ALL` on page 380
`MMEMory:SELect[:ITEM]:DEFault` on page 380
`MMEMory:SELect[:ITEM]:HWSettings` on page 380
`MMEMory:SELect[:ITEM]:LINes:ALL` on page 381
`MMEMory:SELect[:ITEM]:NONE` on page 381
`MMEMory:SELect[:ITEM]:SGRam` on page 381
`MMEMory:SELect[:ITEM]:TRACe[:ACTive]` on page 382
`MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 382

Save File
Saves the settings file with the defined file name.

Note: Secure user mode. In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.
For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Remote command:
`MMEMory:STORe<n>:STATe` on page 384
`MMEMory:STORe<n>:STATe:NEXT` on page 385

Recall in New Channel / Recall in Current Channel
Restores the instrument settings as saved in the selected settings file. If the settings file contains settings for a specific channel only, select "Recall in New Channel" to activate a new channel with the stored settings, or "Recall in Current Channel" to replace the current channel settings.

Note: After you use the "Recall" function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the UNDO/REDO keys.

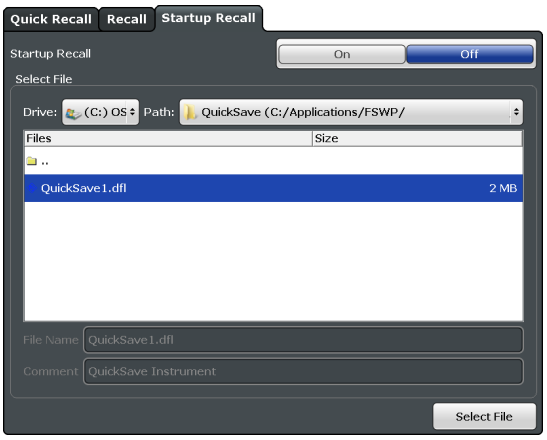
Note: If a measurement channel with the same name as the channel to be restored (in a new channel) is already active, the channel name for the new channel is extended by a consecutive number:

In remote commands, you must append this number to the channel name, as well.

Remote command:
MMEMory:LOAD:STATe on page 383

9.3.2.4 Startup Recall Settings

The "Startup Recall" softkey opens the "Startup Recall" tab of the "Recall" dialog box.



Startup Recall....166
Selecting the Storage Location - Drive/ Path/ Files....166
File Name....167
Comment....167

Startup Recall
Activates or deactivates the startup recall function. If activated, the settings stored in the selected file are loaded each time the instrument is started or preset. If deactivated, the default settings are loaded.

Note that only *instrument* settings files can be selected for the startup recall function, not channel settings files.

Remote command:
MMEMory:LOAD:AUTO on page 383

Selecting the Storage Location - Drive/ Path/ Files
Select the storage location of the settings file on the instrument or an external drive.

The "Drive" indicates the internal (C:) or any connected external drives (e.g. a USB storage device).

The "Path" contains the drive and the complete file path to the currently selected folder.

The "Files" list contains all subfolders and files of the currently selected path.

Note: Saving instrument settings in secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Remote command:
MMEMory:CATalog? on page 374

File Name
Contains the name of the data file without the path or extension.

By default, the name of a settings file consists of a base name followed by an underscore. Multiple files with the same base name are extended by three numbers, e.g. `limit_lines_005`.

For details on the file name and location see chapter 9.3.2.2, "Storage Location and File Name", on page 163.

Note: Saving instrument settings in secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Comment
An optional description for the data file. A maximum of 60 characters can be displayed.

Remote command:
MMEMory:COMMent on page 375

9.3.3 How to Save and Load Instrument Settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the measurement with the same settings. Optionally, user-defined measurement settings can automatically be restored each time you start or preset the instrument.

To save and recall instrument settings using the Quick Save function

1. Select the "Save" icon from the toolbar.
2. Select whether the instrument settings for **all** channels are to be stored, or only those for the **current** channel.
3. Select one of the save sets in which the settings are to be stored ("QuickSaveX").

   The selected settings are stored to the file
   `C:\r_s\instr\user\QuickSave\QuickSaveX.dfl`.

Note: If you make any changes to the settings *after* storing the configuration file, remember to save the settings again. Otherwise those settings cannot be restored and will be overwritten by the stored values when the configuration file is recalled.

4. To restore the settings, select the "Open" icon from the toolbar.
5. Select the save set in which the settings were stored ("QuickSaveX").

   The selected settings are restored to the instrument or channel.

To save configurable instrument settings

1. Select the "Save" icon from the toolbar.
2. In the "Save" dialog box, switch to the "Save" tab.
3. In the file selection dialog box, select a file name and storage location for the settings file.
4. Optionally, define a comment to describe the stored settings.
5. Select whether the instrument settings for **all** channels are to be stored, or only those for the **current** channel.
6. Select the items to be saved with the settings. Either the settings for the currently selected channel only or for all channels can be stored, and various other items such as lines or traces etc. can be stored as well (see chapter 9.3.2.1, "Stored Data Types", on page 162).
7. Select "Save".

   A file with the defined name and path and the extension `.dfl` is created.

If you make any changes to the settings *after* storing the configuration file, remember to save the settings again. Otherwise those settings cannot be restored and will be overwritten by the stored values when the configuration file is recalled.

To recall configurable instrument settings

1. Select the "Open" icon from the toolbar.
2. In the "Recall" dialog box, switch to the "Recall" tab.
3. In the file selection dialog box, select the file name and storage location of the settings file.

   Note: The "File Type" indicates whether the file contains instrument settings for **all** channels, or only those for the current channel.
4. If several items were saved, select which items are to be restored.
5. If channel settings were saved, select whether the settings will replace the settings in the current channel, or whether a new channel with the saved settings will be opened.

6. Select "Recall".

   The settings and selected items from the saved measurement are restored and you can repeat the measurement with the same settings.
   Note that any changes made to the settings *after* storing the configuration file will be overwritten by the stored values when the configuration file is recalled.

To recall settings automatically after preset or reboot

You can define the settings that are restored when you preset or reboot the instrument.

1. Configure the settings as required and save them as described in "To save configurable instrument settings" on page 168.
2. In the "Save/Recall" menu, select the "Startup Recall" softkey.
3. If the file selection dialog box is not displayed automatically, select the "Select Dataset" softkey.
4. Select the recall settings that are to be restored.
5. Select "Select".
6. Toggle the "Startup Recall" softkey to "On".

   Now when you press the PRESET key or reboot the instrument, the defined settings will be restored.
7. To restore the factory preset settings, toggle the "Startup Recall" softkey to "Off".

9.4 Importing and Exporting Measurement Results for Evaluation

The R&S FSWP provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with further, external applications. In this case, you can export the measurement data to a standard format file (ASCII or XML). Some of the data stored in these formats can also be re-imported to the R&S FSWP for further evaluation at a later time, for example in other applications.

The following data types can be exported:

- Trace data
- Table results, such as result summaries, marker peak lists etc.

I/Q data can only be imported and exported in applications that process I/Q data, such as the I/Q Analyzer or optional applications.
See the corresponding user manuals for those applications for details.

- Import/Export Functions 170
- How to Export Trace Data and Numerical Results 170
- Reference: ASCII File Export Format 171

9.4.1 Import/Export Functions

The following import and export functions are available via softkeys in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar.

For a description of the other functions in the "Save/Recall" menu see the R&S FSWP User Manual.

Export....170
└ I/Q Export....170

Export
Opens a submenu to configure data export.

I/Q Export ← Export
Opens a file selection dialog box to select an export file to which the IQ data will be stored. This function is only available in single sweep mode, and only in applications that process I/Q data, such as the I/Q Analyzer or optional applications.

Note: Secure user mode.
In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

9.4.2 How to Export Trace Data and Numerical Results

The measured trace data and numerical measurement results in tables can be exported to an ASCII file. For each measurement point the measured trace position and value are output. The file is stored with a `.DAT` extension. For details on the storage format see chapter 9.4.3, "Reference: ASCII File Export Format", on page 171.

To export trace data and table results

Trace data can be exported from the "Trace" menu.

1. Press the TRACE key, then select the "Trace Config" softkey and switch to the "Trace/Data Export" tab.
2. Select "Export all Traces and all Table Results" to export all available measurement result data for the current application, or select a specific "Trace to Export".
3. Optionally, select the "Include Instrument Measurement Settings" option to insert additional information in the export file header.
4. If necessary, change the decimal separator to be used for the ASCII export file.

5. Select the "Export Trace to ASCII file" button.
6. In the file selection dialog box, select the storage location and file name for the export file.
7. Select "Save" to close the dialog box and export the data to the file.

9.4.3 Reference: ASCII File Export Format

Trace data can be exported to a file in ASCII format for further evaluation in other applications. This reference describes in detail the format of the export files for result data.

(For details see chapter 9.4.2, "How to Export Trace Data and Numerical Results", on page 170).

The file consists of the header information (general configuration of the measurement) and the measurement results. Optionally, the header can be excluded from the file.

The file of the Phase Noise application contains several sections, each section containing related data as shown in the tables below. Each section can contain header information and / or result information (header information is represented by a blue font in the tables below).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on the measurement) which are also separated by a semicolon.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma.

Blue font: header data only written to file if header data is exported, too. **Black font:** result data is always exported to the file	
General measurement configuration	
Type; R&S FSWP;	Instrument model
Version;1.00;	Firmware version
Date;01. Jan 3000;	Date of data set storage
Tune Source;Vtune;	DC power source (Vsupply, Vtune, Vaux or None
VSupply;ON;	State of the supply voltage source (on or off)
Mode;Voltage;	Type of output on the supply voltage source (voltage or current)
Voltage Set;5.000;V;	Output characteristics of the supply voltage
Voltage Min;4.750;V;	
Voltage Max;5.250;V;	
Voltage Meas;0.000;V;	
Current Max;0.050000;A;	
Current Meas;0.000000;A;	
VTune;OFF;	State of the tuning voltage source (on or off)
Voltage Set;5.000;V;	Output characteristics of the tuning voltage
Voltage Min;4.750;V;	
Voltage Max;5.250;V;	
Voltage Meas;0.000;V;	
Current Max;0.050000;A;	
Current Meas;0.000000;A;	
VAux;OFF;	State of the auxiliary voltage source (on or off)
Voltage Set;5.000;V;	Output characteristics of the auxiliary voltage
Voltage Min;4.750;V;	
Voltage Max;5.250;V;	
Voltage Meas;0.000;V;	
Current Max;0.050000;A;	
Current Meas;0.000000;A;	
Mode;Phase Noise;	Application
Measurement;Phase Noise;	Measurement type
Input;RF;	Input source
RF Att;0.000000;dB;	RF attenuation
Coupling;AC;	Input coupling type
RBW;x;%;	Resolution bandwidth factor
XCORR Factor;x;	Cross-correlation factor
XCORR Optimize;ON;	State of cross-correlation optimization
Estimated Meas Time;x;s;	Estimated measurement time
Sweep Count;0;	Current sweep count
Signal frequency;190920481.7452;Hz;	Carrier frequency
Signal level;-43.160000;dBm;	Carrier signal level
Start;1000.000000;Hz;	Start offset frequency
Stop;3000.000000;Hz;	Stop offset frequency

Half decade configuration (amount of data depends on number of half decades in measurement)	
SubSweep;1;	Number of half decade
Start;1000.000000;Hz;	Start offset frequency of half decade
Stop;3000.000000;Hz;	Stop offset frequency of half decade
RBW;30.000000;Hz;	Resolution bandwidth applied in half decade
XCORR Count;10;	Number of cross-correlation operations in half decade
(…)	

Integrated measurement configuration (amount of data depends on number of integration ranges)	
Integrated Measurements Range;1;	Number of integration range
Start;1000.000000;Hz;	Start offset frequency of integration range
Stop;300000.000000;Hz;	Stop offset frequency of integration range
Weighting;ON;FilterName;	State and name of weighting filter
(…)	

Spot noise measurement configuration (amount of data depends on number of spot noise positions)	
SpotNoiseDecadeEdges;ON;	State of spot noise evaluation on decade edges
SpotNoiseUserDefined;ON;	State of user defined spot noise evaluation
SpotNoiseUserDefinedOffset;1;	User defined spot noise information
State;ON;	State of user defined spot noise information
Offset;500000.000000;Hz;	Position of user defined spot noise
(…)	

Noise Spectrum measurement results (amount of data depends on the number of phase measurement windows and the number of traces in each window)	
Window;1;Noise Spectrum;	Number and type of window
Trace;1;	Trace number
Trace Mode;CLR/WRITE;	Trace mode
Trace Result;PN;	Result type (phase noise or amplitude noise etc.)
Smoothing;ON;	State of trace smoothing
Smoothing value;10;%;	Trace smoothing aperture
Spurious Removal;OFF;	State of spur removal
Spurious Removal Threshold;x;dB;	Spur removal threshold
Trace Offset;ON;	State of trace offset
Trace Offset;x;dB;	Value of trace offset
Trace Label;ON;	State of trace label
Trace Label;LabelDesignation;	Trace label
X-Unit;Hz;	Unit of the x-axis
Y-Unit;dBc/Hz;	Unit of the y-axis
Values;601;	Number of measurement points
<x-value>;<y-value>;	Results (one level for every measurement point)
(…)	
Trace;2;	
(…)	
Window;2;PhaseNoise;	
(…)	

Integrated measurement results (amount of data depends on the number of integration ranges)	
Window;3;Integrated Measurements;	Number and type of window
Window;Range;Trace;	Window and trace number a integration range applies to
Start Offset;Unit;	Start offset of the integration range
Stop Offset;Unit;	Stop offset of the integration range
Weighting;	Name of the weighting filter, if present
Int Noise;Unit;	Value for integrated noise
PM;Unit;	Value for the Residual PM
FM;Unit;	Value for the Residual FM
Jitter;Unit;	Value for the jitter
Window;3;Range2;Trace;	
(…)	

Spot noise measurement results (amount of data depends on the number of spot noise markers)	
Window;4;Spot Noise;	Number and type of window
Window;Trace;	Window and trace number the spot noise marker is positioned in
X-Value;Unit;	Position of the spot noise marker
Y-Value;Unit;	Spot noise
(…)	

Spur measurement results (amount of data depends on the number of spurs)	
Window;5;Spurious;	Number and type of window
Window;Trace;	Window and trace number the spurious is found in
Spur;	Number of the spurious
Offset Frequency;Unit;	Offset frequency of the spur
Power;Unit;	Level of the spur
Jitter;Unit;	Jitter of the spur
(…)	
Window;Trace;	Window and trace number the spurious is found in
Discrete Jitter;Unit;	Discrete jitter result
Random Jitter;Unit;	Random jitter result

Marker results (amount of data depends on the number of active markers)	
Window;6;Marker Table;	Number and type of window
Window;	Window the marker is in
Type;	Marker type
Reference;	Reference marker
Trace;	Number of the trace the marker is on
X-Value;Unit;	Position of the marker on the x-axis, incl. unit
Y-Value;Unit;	Position of the marker on the y-axis, incl. unit
(…)	

9.5 Creating Screenshots of Current Measurement Results and Settings

In order to document the graphical results and the most important settings for the currently performed measurement, you can create a hardcopy or screenshot of the current display. Screenshots can either be printed or stored to a file.

- Print and Screenshot Settings.....175
- How to Store or Print Screenshots of the Display.....179

9.5.1 Print and Screenshot Settings

The settings for saving and printing screenshots are configured via the "Print" menu which is displayed when you select the "Print" icon in the toolbar.

For step-by-step instructions see chapter 9.5.2, "How to Store or Print Screenshots of the Display", on page 179.

Remote commands for these settings are described in chapter 12.8, "Managing Settings and Results", on page 372.

To print a screensot of the current display with the current settings immediately, without switching to the "Print" menu, use the "Print immediately" icon at the right-hand side of the toolbar.

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Device Setup..... 176
└ Output Medium..... 177
└ Print Date and Time..... 177
└ Print Logo..... 177
└ Suppress File Name Dialog..... 177
└ Print Dialog..... 177
└ Printer Name..... 178
└ Print to File..... 178
└ Orientation..... 178
Device..... 178
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Install Printer..... 178

Printing or Storing a Screenshot (Print Screen)
Starts to print out or store all measurement results displayed on the screen: diagrams, traces, markers, marker lists, limit lines, etc., including the channel and status bars. Optionally, comments and the date and time are included at the bottom margin of the printout. All displayed items belonging to the software user interface (e.g. softkeys or dialog boxes) are not printed out.

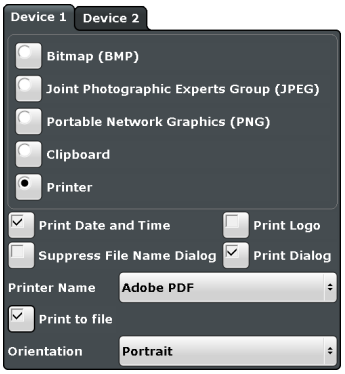
Whether the output is sent to the printer or stored in a file or the clipboard depends on the selected device and the device settings.

If the output is stored to a file, a file selection dialog box is opened to select the file name and location. The default path is `C:\r_s\instr\user`.

The "Print" menu is displayed to configure printing.

Remote command:
`HCOPy:ITEM:ALL` on page 391
`HCOPy[:IMMediate<device>]` on page 390
`HCOPy[:IMMediate<device>]:NEXT` on page 390

Device Setup
Defines the behavior of the "Print Screen" function, depending on which device is selected. Two different devices can be configured, e.g. one for printing and one for storage to a file.



Output Medium ← Device Setup
Defines the medium to which the screenshot is printed or stored.

"File formats" Stores the screenshot to a file in the selected format. The file name is queried at the time of storage.

"Clipboard" Stores the screenshot to the clipboard.

"Printer" Prints the screenshot on the printer selected from the "Name" list.

Remote command:
`HCOPy:DEVice:LANGuage<device>` on page 390

Print Date and Time ← Device Setup
Activates/deactivates the printout of the current date and time at the bottom of the screenshot.

Remote command:
`HCOPy:TDSTamp:STATe<device>` on page 391

Print Logo ← Device Setup
Activates/deactivates the printout of the Rohde & Schwarz company logo in the upper left corner.

Remote command:
`DISPlay:LOGO` on page 387

Suppress File Name Dialog ← Device Setup
When the screenshot is stored to a file, the file selection dialog box is not displayed. Instead, the current storage location and file name are used (default: `C:\r_S\instr\user`). Each new the file name is extended by a consecutive number, e.g. `File002`, `File003` etc.

Print Dialog ← Device Setup
Includes any currently displayed dialog in the screenshot.

Printer Name ← Device Setup
Defines the printer to print to.

Remote command:
SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]? on page 392
SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt? on page 392
SYSTem:COMMunicate:PRINter:SELect<device> on page 392

Print to File ← Device Setup
If a printer is selected as the output medium, use this option to store the data in a `.prn` file using the selected printer driver.

Orientation ← Device Setup
Selects the page orientation of the printout: portrait or landscape (printer only)

Remote command:
HCOPy:PAGE:ORIentation<device> on page 391

Device
Two different printout devices can be configured, e.g. one for printing and one for storage to a file. When the "Print Screen" function is executed, the selected device and its settings determine the behavior.

Remote command:
HCOPy:DESTination<device> on page 389

Colors
Opens the "Print Color" dialog box to configure the colors for printing screenshots. For details see "Print colors" on page 204.

Comment
Defines an optional comment to be printed with the screenshot of the display. Maximum 120 characters are allowed. 60 characters fit in one line. In the first line, at any point a manual line-feed can be forced by entering "@".

Date and time are inserted automatically. The comment is printed below the diagram area, but not displayed on the screen. If a comment should not be printed, it must be deleted.

Remote command:
HCOPy:ITEM:WINDow:TEXT on page 391

Install Printer
Opens the standard Windows dialog box to install a new printer. All printers that are already installed are displayed.

Only user accounts with administrator rights can install a printer.

For further information refer to the Microsoft Windows documentation.

9.5.2 How to Store or Print Screenshots of the Display

► If the R&S FSWP has already been set up according to your current requirements, simply press the "Print immediate" icon ( ) at the far right end of the toolbar.

A screenshot of the current measurement display is printed or stored to a file, as configured.

To set up screenshot outputs

This configuration assumes a printer has already been installed. To install a new printer, use the Install Printer softkey.

1. Select the "Printer" tool in the toolbar.
2. Select the "Device Setup" softkey.
3. Select the tab for Device 1 or Device 2 to configure a device.
4. To set up the print function to store a screenshot to a file, select the required file format as the output medium.
   To set up the print function to store a screenshot to the clipboard, select "Clipboard" as the output medium.
   To set up the print function to print a screenshot on a printer, select "Printer" as the output medium and an installed printer from the "Name" list.
5. For printout, select the page orientation.
6. Optionally, deactivate the date and time or the logo so they are not added to the screenshot.
7. Select "OK" to close the "Device Setup" dialog box.
8. Toggle the "Device" softkey to the device configuration you want to use.
9. Optionally, configure the colors to be used for printout, e.g. as displayed on the screen instead of inversed.
10. Optionally, add a comment to be included with the screenshot.
11. Select the "Print Screen" softkey or the "Printer" or "Screenshot" tool in the toolbar to execute the print function and check the results.
12. If you configured the print function to store the screenshot to a file, enter a file name in the file selection dialog box.

10 General Instrument Setup

Some basic instrument settings can be configured independently of the selected operating mode or application. Usually, you will configure most of these settings initially when you set up the instrument according to your personal preferences or requirements and then only adapt individual settings to special circumstances when necessary. Some special functions are provided for service and basic system configuration.

- Basics on Alignment 180
- General Instrument Settings 181
- Display Settings 198
- External Monitor Settings 206
- How to Configure the Basic Instrument Settings 207

10.1 Basics on Alignment

When you put the instrument into operation for the first time or when strong temperature changes occur, it may be necessary to align the data to a reference source (see also "Temperature check" on page 181).

During instrument start, the installed hardware is checked against the current firmware version to ensure the hardware is supported. If not, an error message is displayed ("WRONG_FW") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails.

The correction data and characteristics required for the alignment are determined by comparison of the results at different settings with the known characteristics of the high-precision calibration signal source at 64 MHz.

If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed.

Alignment results

The alignment results are displayed and contain the following information:

- date and time of last correction data record
- overall results of correction data record
- list of found correction values according to function/module

The results are classified as follows:

PASSED	Calibration successful without any restrictions
CHECK	Deviation of correction value larger than expected, correction could however be performed
FAILED	Deviations of correction value too large, no correction was possible. The found correction data is not applicable.

The results are available until the next self-alignment process is started or the instrument is switched off.

Temperature check

A temperature check is only done in the optional Spectrum application.

During self-alignment, the instrument's (frontend) temperature is also measured (as soon as the instrument has warmed up completely). This temperature is used as a reference for a continuous temperature check during operation. If the current temperature deviates from the stored self-alignment temperature by a certain degree, a warning is displayed in the status bar indicating the resulting deviation in the measured power levels. A status bit in the `STATUs:QUEStionable:TEMPerature` register indicates a possible deviation. The current temperature of the RF Frontend can be queried using a remote command (see `SOURce:TEMPerature:FRONtend?` on page 403).

Touchscreen alignment

When the device is delivered, the touchscreen is initially calibrated. However, to ensure that the touchscreen responds to the finger contact correctly, a touchscreen alignment is required.

Alignment of the touchscreen is useful:

- At first use
- After an image update or after exchanging a hard disk
- If you notice that touching a specific point on the screen does not achieve the correct response
- If the position of the instrument has been changed and you cannot look straight on the screen
- If another person operates the instrument

10.2 General Instrument Settings

Access: SETUP

Network and Remote Settings, Display Settings

Settings for network and remote operation are described in chapter 11, "Network and Remote Operation", on page 212.

Display settings are described in chapter 10.3, "Display Settings", on page 198.

- Reference Frequency Settings....182
- Alignment Settings....185
- System Configuration Settings....186
- Service Functions....192

10.2.1 Reference Frequency Settings

Access: SETUP > "Reference"

Reference Frequency Input....182
- Behavior in case of missing external reference....183
- Tuning Range....184
- Frequency....184
- Loop Bandwidth....184

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Reference Frequency Input

The R&S FSWP can use the internal reference source or an external reference source as the frequency standard for all internal oscillators. A 10 MHz crystal oscillator is used as the internal reference source. In the external reference setting, all internal oscillators of the R&S FSWP are synchronized to the external reference frequency.

External references are connected to one of the REF INPUT or the SYNC TRIGGER connectors on the rear panel. For details see the "Getting Started" manual.

Note: The optional, and more precise OCXO signal can replace the internal reference source.

The default setting is the internal reference. When an external reference is used, "EXT REF" is displayed in the status bar.

The following reference inputs are available:

Table 10-1: Available Reference Frequency Input

Source	Frequency	Tuning Range	Loop Bandwidth	Description
Internal	10 MHz	-	1-100 Hz	Internal reference signal or optional OCXO
External Reference 10 MHz	10 MHz	+/- 6 ppm	1-100 Hz	External reference from REF INPUT 1..20 MHZ connector; Fixed external 10 MHZ reference frequency. Good phase noise performance
External Reference 1..20 MHz	1..20 MHz in 1 Hz steps	+/- 0.5 ppm	0.1 Hz (fixed)	Variable external reference frequency in 0.1 Hz steps from REF INPUT 1..20 MHZ connector; Good external phase noise suppression. Small tuning range.
		+/- 6 ppm	1-30 Hz	Variable external reference frequency in 0.1 Hz steps from REF INPUT 1..20 MHZ connector; Wide tuning range.
External Reference 100 MHz	100 MHz	+/- 6 ppm	1-300 Hz	External reference from REF INPUT 100 MHZ connector Good phase noise performance
Sync Trigger	100 MHz	+/- 6 ppm	1-300 Hz	External reference from SYNC TRIGGER INPUT connector

Remote command:
`[SENSe:]ROSCillator:SOURce` on page 398
`SOURce:EXTernal:ROSCillator:EXTernal:FREQuency` on page 398

Behavior in case of missing external reference ← Reference Frequency Input
If an external reference is selected but none is available, there are different ways the instrument can react.

"Show Error Flag" — The message "NO REF" is displayed to indicate that no synchronization is performed.

"Switch to internal reference" — The instrument automatically switches back to the internal reference if no external reference is available. Note that you must re-activate the external reference if it becomes available again at a later time.

Remote command:
`[SENSe:]ROSCillator:SOURce` on page 398
`[SENSe:]ROSCillator:SOURce:EAUTo?` on page 399

Tuning Range ← Reference Frequency Input
The tuning range is only available for the variable external reference frequency. It determines how far the frequency may deviate from the defined level in parts per million (10^{-6}).

"+/- 0.5 ppm" With this smaller deviation a very narrow fixed loop bandwidth of 0.1 Hz is realized. With this setting the instrument can synchronize to an external reference signal with a very precise frequency. Due to the very narrow loop bandwidth, unwanted noise or spurious components on the external reference input signal are strongly attenuated. Furthermore, the loop requires about 30 seconds to reach a locked state. During this locking process, "NO REF" is displayed in the status bar.

"+/- 6 ppm" The larger deviation allows the instrument to synchronize to less precise external reference input signals.

Remote command:
`[SENSe:]ROSCillator:TRANge` on page 400

Frequency ← Reference Frequency Input
Defines the external reference frequency to be used (for variable connectors only).

Loop Bandwidth ← Reference Frequency Input
Defines the speed of internal synchronization with the reference frequency. The setting requires a compromise between performance and increasing phase noise.

For a variable external reference frequency with a narrow tuning range (+/- 0.5 ppm), the loop bandwidth is fixed to 0.1 Hz and cannot be changed.

Remote command:
`[SENSe:]ROSCillator:LBWidth` on page 397

Reference Frequency Output
A reference frequency can be provided by the R&S FSWP to other devices that are connected to this instrument. If one of the following options is activated, the reference signal is output to the corresponding connector.

"Output 100 MHz"
Provides a 100 MHz reference signal to the REF OUTPUT 100 MHZ connector.

"Ouput 640 MHz"
Provides a 640 MHz reference signal to the REF OUTPUT 640 MHZ connector.

"Output Sync Trigger"
Provides a 100 MHz reference signal to the SYNC TRIGGER OUTPUT connector.

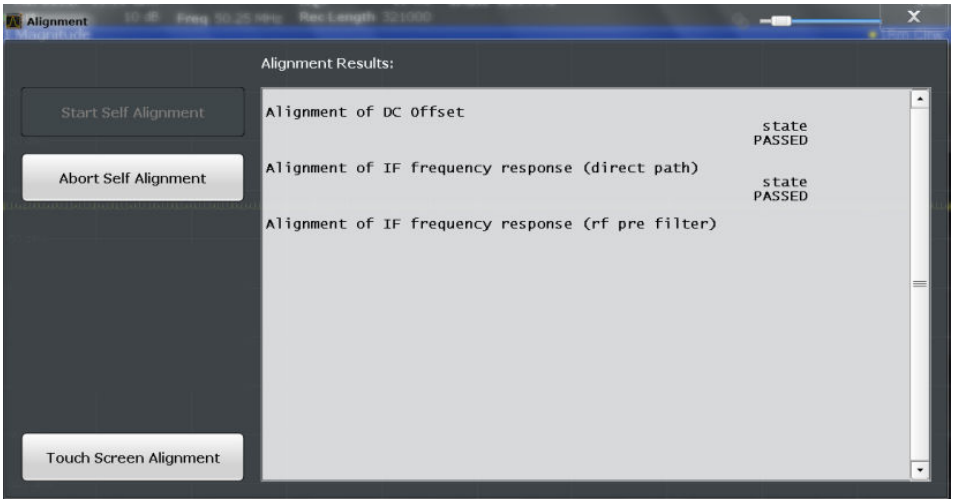
Remote command:
`[SENSe:]ROSCillator:O100` on page 397
`[SENSe:]ROSCillator:O640` on page 398
`[SENSe:]ROSCillator:OSYNc` on page 398

Resetting the Default Values
The values for the "Tuning Range", "Frequency" and "Loop Bandwidth" are stored for each source of "Reference Frequency Input". Thus, when you switch the input source, the previously defined settings are restored. You can restore the default values for all input sources using the "Preset Channel" function.

10.2.2 Alignment Settings

Access: SETUP > "Alignment"

Both the instrument and the touchscreen can be aligned when necessary (see chapter 10.1, "Basics on Alignment", on page 180).



Self-alignment results in secure user mode
Be sure to store self-alignment results before Secure User Mode is enabled; see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

If the currently stored self-alignment results are not suitable, you must perform a self-alignment each time you switch on the R&S FSWP in secure user mode, as the results are not stored permanently in this case.

Starting a Self-alignment....185
Aborting the Self-alignment....186
Starting the Touchscreen Alignment....186
Alignment Results....186

Starting a Self-alignment
Starts recording correction data for the instrument. If the correction data acquisition fails or if the correction values are deactivated, a corresponding message is displayed in the status field.

For details see chapter 10.1, "Basics on Alignment", on page 180.

Note:

A running Sequencer operation is aborted when you start a self-alignment.

Remote command:
*CAL? on page 280, see also CALibration[:ALL]? on page 400

Aborting the Self-alignment
As long as the self-alignment data is being collected the procedure can be cancelled using the "Abort Self-alignment" button.

Note: If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed. In this case, you cannot abort a self-alignment manually.

Starting the Touchscreen Alignment
Starts the touchscreen alignment.

Tap the 4 markers on the screen as you are asked to do. The touchscreen is aligned according to the executed pointing operations.

Alignment Results
Information on whether the alignment was performed succesfully and on the applied correction data is displayed. The results are available until the next self-alignment process is started or the instrument is switched off.

Remote command:
CALibration:RESult? on page 401

10.2.3 System Configuration Settings

Access: SETUP > "System Configuration"

- Hardware Information....186
- Information on Versions and Options....187
- System Messages....188
- Firmware Updates....189
- General Configuration Settings....190

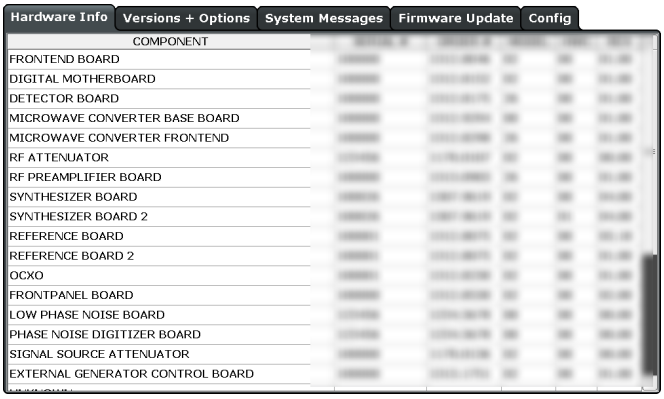
10.2.3.1 Hardware Information

Access: SETUP > "System Configuration" > "Hardware Info"

An overview of the installed hardware in your R&S FSWP is provided.

Every listed component is described by its serial number, order number, model information, hardware code, and hardware revision.

This information can be useful when problems occur with the instrument and you require support from Rohde & Schwarz.



Remote command:

`DIAGnostic:SERVice:HWINfo?` on page 415

10.2.3.2 Information on Versions and Options

Access: SETUP > "System Configuration" > "Versions Options"

Information on the firmware version and options installed on your instrument is provided. The unique Rohde & Schwarz device ID is also indicated here, as it is required for license and option administration.

You can also install new firmware options in this dialog box.

Installing options in secure user mode

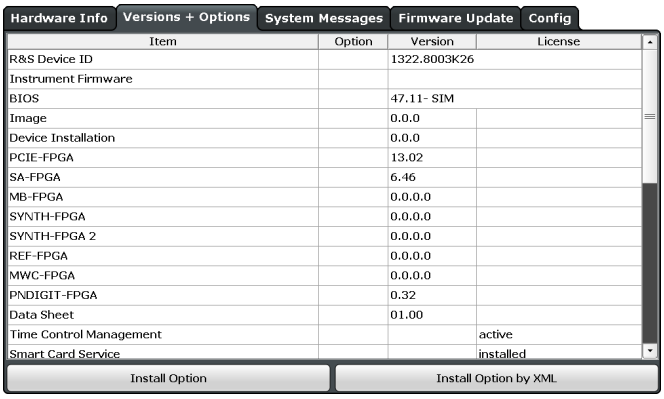
Be sure to install any new options before Secure User Mode is enabled; see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

For restricted users in secure user mode, this function is not available!

Expired option licenses

If an option is about to expire, a message box is displayed to inform you. You can then use the "Install Option" function to enter a new license key.

If an option has already expired, a message box appears for you to confirm. In this case, all instrument functions are unavailable (including remote control) until the R&S FSWP is rebooted. You must then use the "Install Option" function to enter the new license key.



For details on options refer to the "Getting Started" manual, "Checking the Supplied Items".

Remote commands:

`SYSTem:FORMat:IDENt` on page 418

`DIAGnostic:SERVice:BIOSinfo?` on page 415

`DIAGnostic:SERVice:VERSinfo?` on page 415

Install Option
Opens an edit dialog box to enter the license key for the option that you want to install.

Only user accounts with administrator rights are able to install options.

Install Option by XML
Opens a file selection dialog box to install an additional option to the R&S FSWP using an XML file. Enter or browse for the name of an XML file that contains the option key and press "Select".

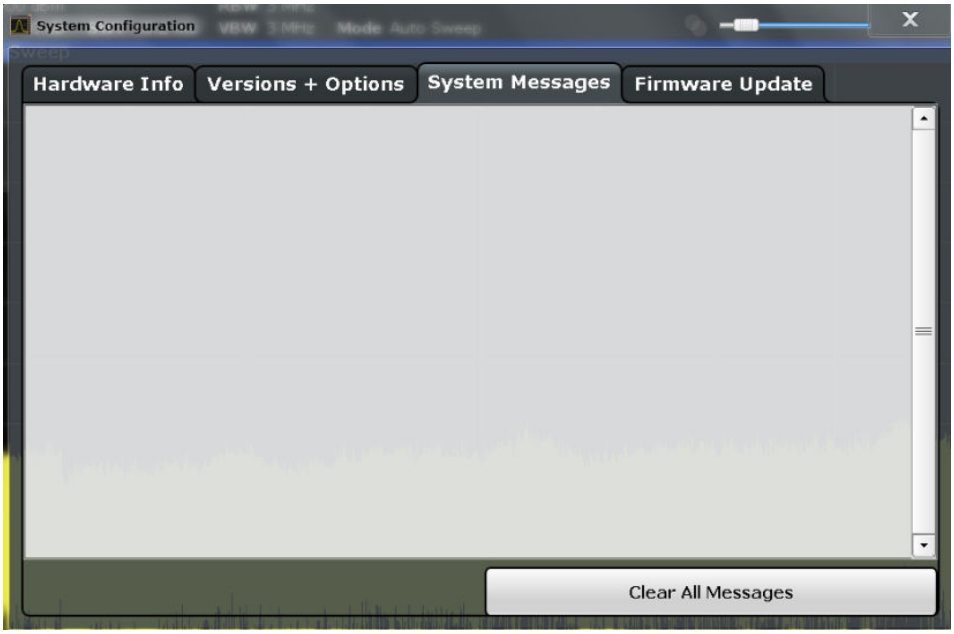
Only user accounts with administrator rights are able to install options.

10.2.3.3 System Messages

Access: SETUP > "System Configuration" > "System Messages"

The system messages generated by the R&S FSWP are displayed.

The messages are displayed in the order of their occurrence; the most recent messages are placed at the top of the list. Messages that have occurred since you last visited the system messages tab are marked with an asterisk '*'.



If the number of error messages exceeds the capacity of the error buffer, "Message buffer overflow" is displayed. To clear the message buffer use the "Clear All Messages" button.

The following information is available:

No	device-specific error code
Message	brief description of the message
Component	hardware messages: name of the affected module
	software messages: name of the affected software
Date/Time	date and time of the occurrence of the message

Remote command:

`SYSTem:ERRor:LIST?` on page 417

10.2.3.4 Firmware Updates

Access: SETUP > "System Configuration" > "Firmware Update"

During instrument start, the installed hardware is checked against the current firmware version to ensure the hardware is supported. If not, an error message is displayed ("WRONG_FW") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails. To see which components are not supported, see the System Messages.

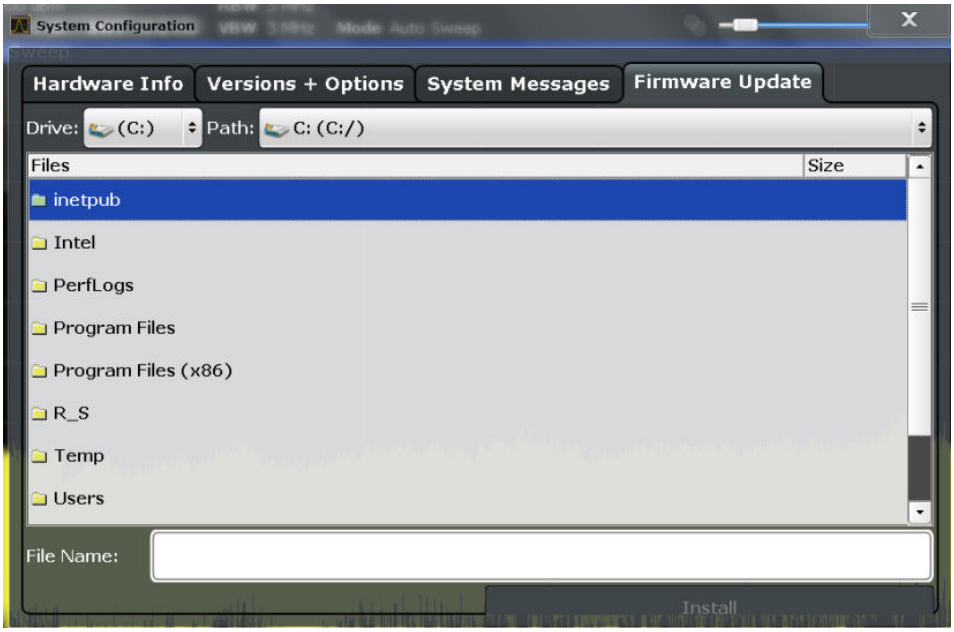
The firmware on your R&S FSWP may also need to be updated in order to enable additional new features or if reasons for improvement come up. Ask your sales representative or check the Rohde&Schwarz website for availability of firmware updates. A firmware update package includes at least a setup file and release notes.

Before updating the firmware on your instrument, read the release notes delivered with the firmware version.

Installing options in secure user mode

Be sure to perform any firmware updates before Secure User Mode is enabled; see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

For restricted users in secure user mode, this function is not available!



Enter the name or browse for the firmware installation file and press the "Install" button.

Remote command:

`SYSTem:FIRMware:UPDate` on page 418

10.2.3.5 General Configuration Settings

Access: SETUP > "System Configuration" > "Config"

General system settings, for example concerning the initial behaviour of the R&S FSWP after booting, can also be configured.

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Out-of-range value behavior....191
Secure User Mode....191
└ Changing the password....192

Preset Mode
The preset mode selects the application that is started after an instrument preset.

The presettings can be defined in the "Config" tab of the "System Configuration" dialog box.

For details on operating modes see chapter 5, "Applications", on page 78.

"SAN"	Signal and Spectrum Analyzer mode (Only when the optional Spectrum application has been installed.)
"MSRA"	Multi-Standard Radio Analysis mode (Only when the optional Spectrum application has been installed.)
"PNO"	Phase Noise application

Remote command:
`SYSTem:PRESet:COMPatible` on page 418

Out-of-range value behavior
By default, if you enter a value that is outside the valid range in an input field for a setting, a warning is displayed and the value is not accepted. Alternatively, entries below the minimum value can automatically be set to the minimum possible entry, and entries above the maximum value set to the maximum possible entry. This behavior avoids errors and facilitates setting correct values.

Secure User Mode
If activated, the R&S FSWP requires a reboot and then automatically logs in using the "SecureUser" account.

Data that the R&S FSWP normally stores on the solid-state drive is redirected to volatile memory instead. Data that is stored in volatile memory can be accessed by the user during the current instrument session; however, when the instrument's power is removed, all data in volatile memory is erased.

The Secure User Mode can only be activated or deactivated by a user with administrator rights.

Note: Storing instrument settings permanently. Before you activate secure user mode, store any instrument settings that are required beyond the current session, such as predefined instrument settings, transducer files, or self-alignment data.

For details on the secure user mode see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Remote command:
`SYSTem:SECurity[:STATe]` on page 419
Note: Initially after installation of the R&S FSWP-K33 option, secure user mode must be enabled manually once before remote control is possible.

Changing the password ← Secure User Mode
When the secure user mode is activated the first time after installation, you are prompted to change the passwords for all user accounts in order to improve system security.

To save the new password, select "Save". The password dialog for the next user is displayed, until you have been prompted to change the password all user accounts.

If you cancel the dialog without changing the password, the password dialog for the next user is displayed, until you have been prompted to change the password all user accounts. Although it is possible to continue in secure user mode without changing the passwords (and you will not be prompted to do so again), it is strongly recommended that you do define a more secure password for all users.

By default, the password characters are not displayed to ensure confidentiality during input. To display the characters, select "Show password".

To display the onscreen keyboard, select "Keyboard".

10.2.4 Service Functions

Access: SETUP > "Service"

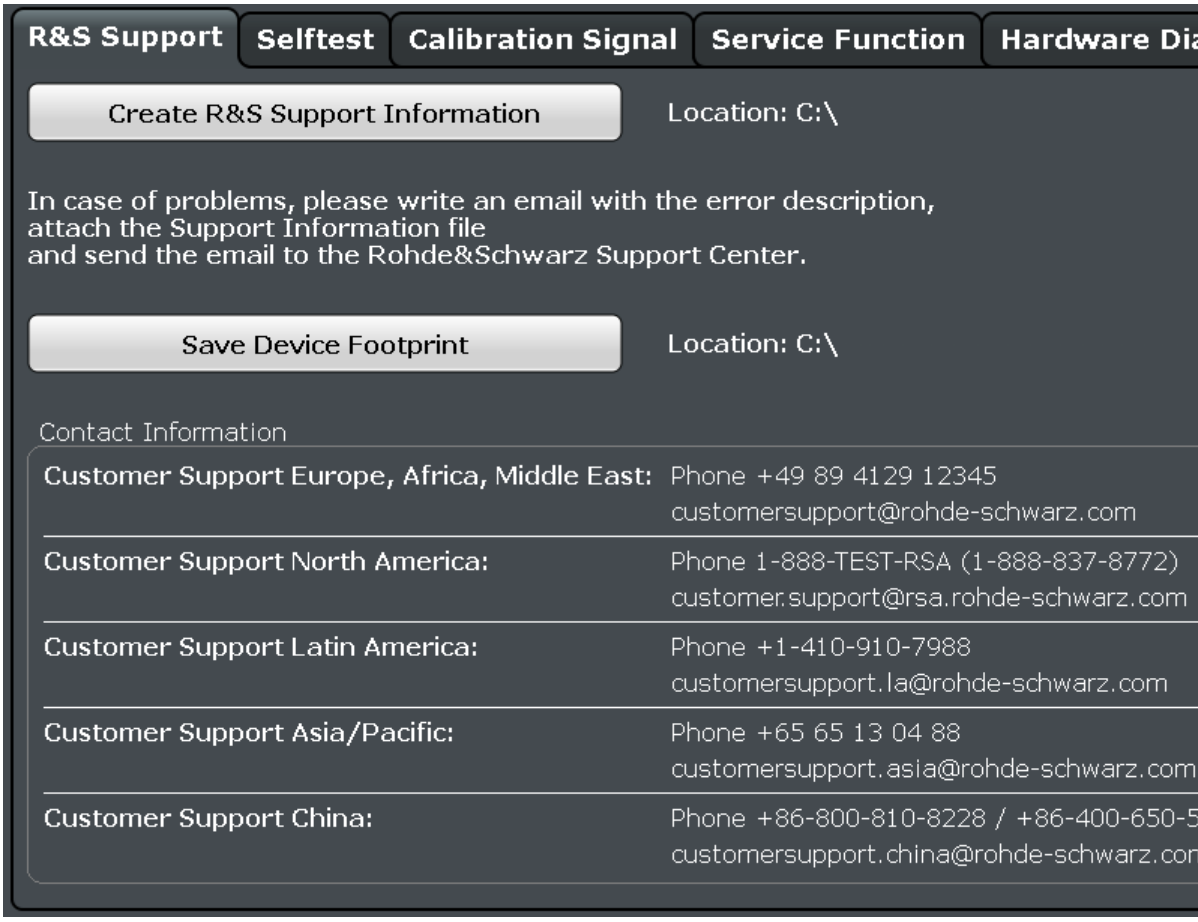
When unexpected problems arise with the R&S FSWP some service functions may help you solve them.

- R&S Support Information 192
- Self-test Settings and Results 194
- Calibration Signal Display 194
- Service Functions 196
- Hardware Diagnostics 197

10.2.4.1 R&S Support Information

Access: SETUP > "Service" > "R&S Support"

In case of errors you can store useful information for troubleshooting and send it to your Rohde & Schwarz support center.



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Creating R&S Support Information
Creates a *.zip file with important support information. The *.zip file contains the system configuration information ("device footprint"), the current eeprom data and a screenshot of the screen display.

This data is stored to the `C:\R_S\Instr\user\` directory on the instrument.

The file name consists of the unique device ID and the current date and time of the file creation.

If you contact the Rohde&Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

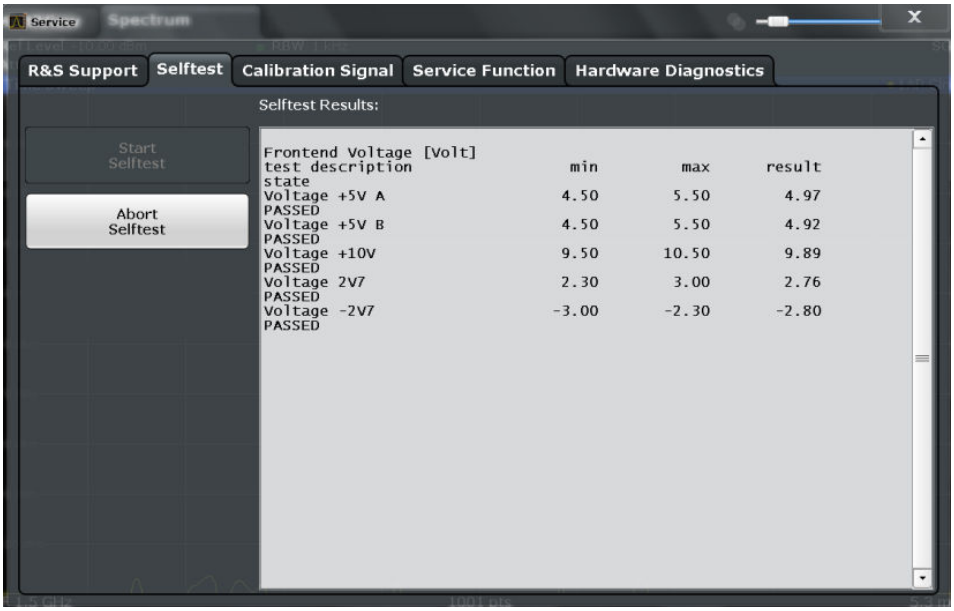
Remote command:
`DIAGnostic:SERVice:SINFo?` on page 421

Save Device Footprint
Creates an *.xml file with information on installed hardware, software, image and FPGA versions. The *.xml file is stored under `C:\R_S\Instr\devicedata\xml\` on the instrument. It is also included in the `service.zip` file.

10.2.4.2 Self-test Settings and Results

Access: SETUP > "Service" > "Self-test"

If the R&S FSWP fails you can perform a self-test of the instrument to identify any defective modules.



Once the self-test is started, all modules are checked consecutively and the test result is displayed. You can abort a running test.

In case of failure a short description of the failed test, the defective module, the associated value range and the corresponding test results are indicated.

A running Sequencer process is aborted when you start a self-test.

If you start a self-test remotely, then select the "Local" softkey while the test is still running, the instrument only returns to the manual operation state after the test is completed. In this case, the self-test cannot be aborted.

Remote command:

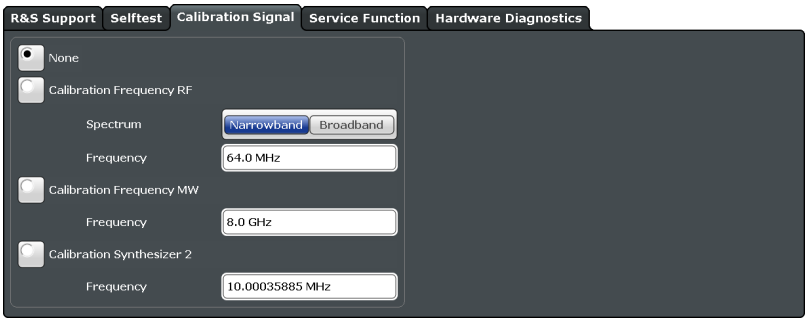
`*TST?` on page 284

`DIAGnostic:SERVice:STESt:RESult?` on page 403

10.2.4.3 Calibration Signal Display

Access: SETUP > "Service" > "Calibration Signal"

Alternatively to the RF input signal from the front panel connector you can use the instrument's calibration signal as the input signal, for example to perform service functions on.



None 195
Calibration Frequency RF 195
└ Spectrum 195
└ Frequency 195
Calibration Frequency MW 195
Calibration Synthesizer 2 196

None
Uses the current RF signal at the input, i.e. no calibration signal (default).

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 402

Calibration Frequency RF
Uses the internal calibration signal as the RF input signal.

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 402
`DIAGnostic:SERVice:INPut:PULSed:CFRequency` on page 402

Spectrum ← Calibration Frequency RF
Defines whether a broadband or narrowband calibration signal is sent to the RF input.

"Narrowband" Used to calibrate the absolute level of the frontend at 64 MHz.

"Broadband" Used to calibrate the IF filter.

Remote command:
`DIAGnostic:SERVice:INPut:RF:SPECtrum` on page 402

Frequency ← Calibration Frequency RF
Defines the frequency of the internal broadband calibration signal to be used for IF filter calibration (max. 64 MHz). For narrowband signals, 64 MHz is sent.

Calibration Frequency MW
Uses the microwave calibration signal as the RF input (for frequencies greater than 8 GHz). This function is used to calibrate the YIG-filter on the microwave converter. The microwave calibration signal is pulsed. You can define whether the distance between input pulses is small or wide.

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 402
`DIAGnostic:SERVice:INPut:MC:DISTance` on page 401

Calibration Synthesizer 2
This function is used to check the phase noise of the synthesizers on a certain frequency. You can define the frequency in the corresponding input field.

If you enter a frequency on which calibration is not possible, the R&S FSWP uses the next available frequency.

Available if the R&S FSWP is equipped with the optional hardware and has more than one synthesizer.

For more information on the calibration process, refer to the Service Manual.

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 402
`DIAGnostic:SERVice:INPut:SYNThtwo[:FREQuency]` on page 403

10.2.4.4 Service Functions

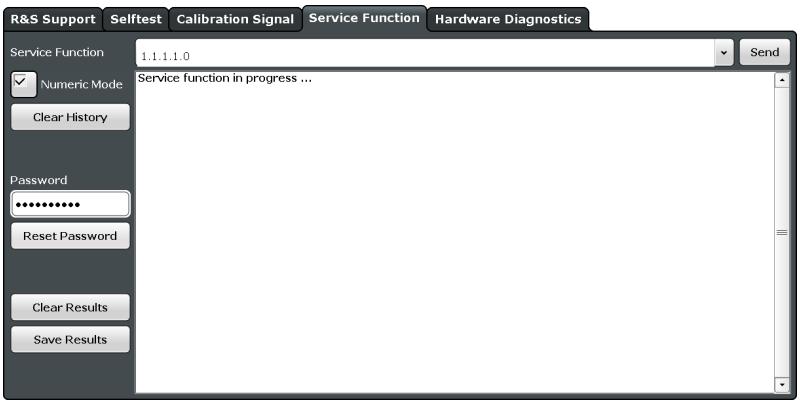
Access: SETUP > "Service" > "Service Function"

NOTICE

Using service functions

The service functions are not necessary for normal measurement operation. Incorrect use can affect correct operation and/or data integrity of the R&S FSWP.

Therefore, only user accounts with administrator rights can use service functions and many of the functions can only be used after entering a password. These functions are described in the instrument service manual.



Service Function 197
Numeric Mode 197
Send 197
Clear History 197
Password 197
Clear Results 197
Save Results 197
Result List 197

Service Function
Selects the service function by its numeric code or textual name.

The selection list includes all functions previously selected (since the last "Clear History" action).

Remote command:
DIAGnostic:SERVice:SFUNction on page 420

Numeric Mode
If activated, the service function is selected by its numeric code. Otherwise, the function is selected by its textual name.

Send
Starts the selected service function.

Remote command:
DIAGnostic:SERVice:SFUNction on page 420

Clear History
Deletes the list of previously selected service functions.

Password
Most service functions require a special password as they may disrupt normal operation of the R&S FSWP. There are different levels of service functions, depending on how restrictive their use is handled. Each service level has a different password.

"Reset Password" returns to the lowest (least restrictive) service level.

Clear Results
Clears the result display for all previously performed service functions.

Remote command:
DIAGnostic:SERVice:SFUNction:RESults:DELete on page 420

Save Results
Opens a file selection dialog box to save the results of all previously performed service functions to a file.

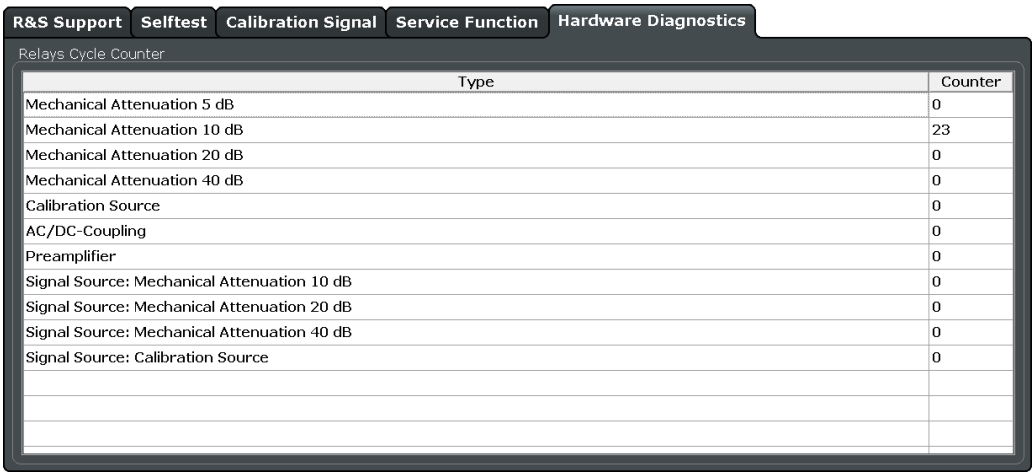
Remote command:
DIAGnostic:SERVice:SFUNction:RESults:SAVE on page 420

Result List
The Results List indicates the status and results of the executed service functions.

10.2.4.5 Hardware Diagnostics

In case problems occur with the instrument hardware, some diagnostic tools provide information that may support troubleshooting.

The hardware diagnostics tools are available in the "Hardware Diagnostics" tab of the "Service" dialog box.



Type	Counter
Mechanical Attenuation 5 dB	0
Mechanical Attenuation 10 dB	23
Mechanical Attenuation 20 dB	0
Mechanical Attenuation 40 dB	0
Calibration Source	0
AC/DC-Coupling	0
Preamplifier	0
Signal Source: Mechanical Attenuation 10 dB	0
Signal Source: Mechanical Attenuation 20 dB	0
Signal Source: Mechanical Attenuation 40 dB	0
Signal Source: Calibration Source	0

Relay Cycle Counter..... 198

Relay Cycle Counter
The hardware relays built into the R&S FSWP may fail after a large number of switching cycles (see data sheet). The counter indicates how many switching cycles the individual relays have performed since they were installed.

Remote command:
`DIAGnostic:INFO:CCOunter?` on page 414

10.3 Display Settings

Access: SETUP > "Display"

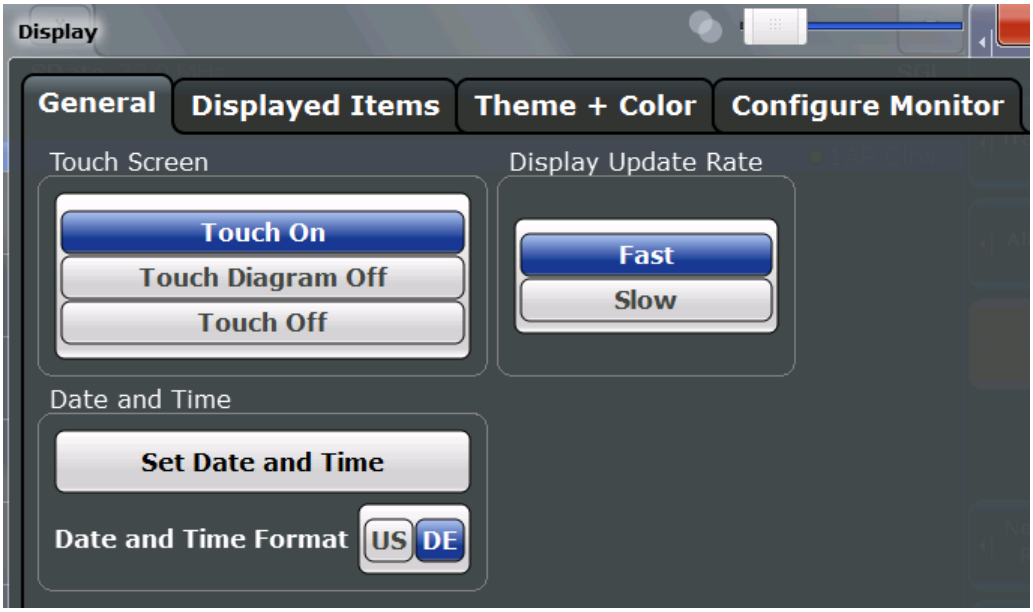
Some general display settings are available regardless of the current application or operating mode. For information on optimizing your display for measurement results see chapter 8.1, "Result Display Configuration", on page 120.

- General Display Settings.....198
- Displayed Items.....200
- Display Theme and Colors.....203

10.3.1 General Display Settings

Access: SETUP > "Display" > "General"

This section includes general screen display behavior and date and time display.



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Display Update Rate 199
Setting the Date and Time 199
Date and Time Format 200

Deactivating and Activating the Touchscreen

The touchscreen function can be deactivated, e.g. when the instrument is being used for demonstration purposes and tapping the screen should not provoke an action.

To reactivate the touchscreen, simply press the SETUP key on the front panel. The "Display" dialog box is opened automatically and the "touchscreen" option is set to "ON".

"TOUCH ON" Touchscreen function is active for the entire screen

"TOUCH OFF" Touchscreen is deactivated for the entire screen

"TOUCH DIAGRAM OFF"
Touchscreen is deactivated for the diagram area of the screen, but active for the surrounding softkeys, toolbars and menus

Remote command:
`DISPlay:TOUChscreen:STATe` on page 405

Display Update Rate

By default, a fast update rate ensures the most recent measurement results on the display. However, when performance is poor due to slow data transfer (for example during remote control), it may be helpful to decrease the frequency with which the screen display is updated.

Setting the Date and Time

The current date and time on the instrument is set using the standard Windows "Date and Time Properties" dialog box which is displayed when you select the "Set Date and Time" button in the "Display" dialog box, or when you select the date and time display in the status bar.

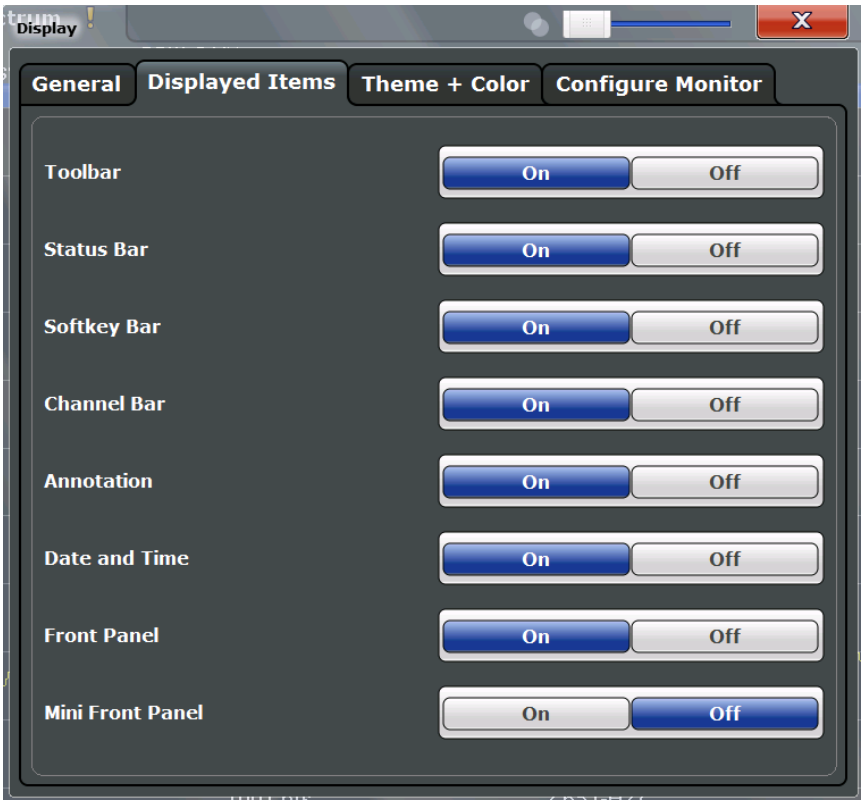
Date and Time Format
Switches the time and date display on the screen between US and German (DE) format.

Remote command:
`DISPlay[:WINDow]:TIME:FORMat` on page 406

10.3.2 Displayed Items

Access: SETUP > "Display" > "Displayed Items"

Several elements on the screen display can be hidden or shown as required, for example to enlarge the display area for the measurement results.



Toolbar....201
Status Bar....201
Softkey Bar....201
Channel Bar....201
Diagram Footer (Annotation)....201
Date and Time....201
Front Panel....202
Mini Front Panel....202

Toolbar
The toolbar provides access to frequently used functions via icons at the top of the screen. Some functions, such as zooming, finding help, printing screenshots or storing and loading files are not accessible at all without the toolbar.

Remote command:
`DISPlay:TBAR[:STATe]` on page 405

Status Bar
The status bar beneath the diagram indicates the global instrument settings, the instrument status and any irregularities during measurement or display.

Some of the information displayed in the status bar can be queried from the status registry via remote commands.

Remote command:
`DISPlay:SBAR[:STATe]` on page 405

Softkey Bar
Softkeys are virtual keys provided by the software. Thus, more functions can be provided than those that can be accessed directly via the function keys on the device.

The functions provided by the softkeys are often also available via dialog boxes. However, some functions may not be accessible at all without the softkey bar.

The softkey bar can be hidden temporarily to provide more space for the result displays on the screen. If you switch the "Softkey Bar" display off, it is only displayed for a few seconds when you select a key. Thus, you can access the functionality. Then the bar is hidden again until the next time you select a key or switch the "Softkey Bar" display back on.

Note: The softkey bar is hidden while the SmartGrid is displayed and restored automatically when the SmartGrid is closed.

Remote command:
`DISPlay:SKEYs[:STATe]` on page 405

Channel Bar
The channel bar provides information on firmware and measurement settings for a specific measurement channel.

Remote command:
`DISPlay:ANNotation:CBAR` on page 404

Diagram Footer (Annotation)
The diagram footer beneath the diagram contains information on the x-axis of the diagram display, such as the current center frequency and span settings, the displayed span per division and the number of sweep points.

Remote command:
`DISPlay:ANNotation:FREQuency` on page 404

Date and Time
The date and time display can be switched off independently of the status bar.

You can set the current date and time and configure the display format in the "General" tab of the "Display" dialog box.

Remote command:
`DISPlay[:WINDow]:TIME` on page 406

Front Panel
The "Front Panel" display simulates the entire front panel of the device (except for the external connectors) on the screen. This allows you to interact with the R&S FSWP without requiring the keypad and keys located on the front panel of the device. This is useful, for example, when working with an external monitor or operating via remote control from a computer.

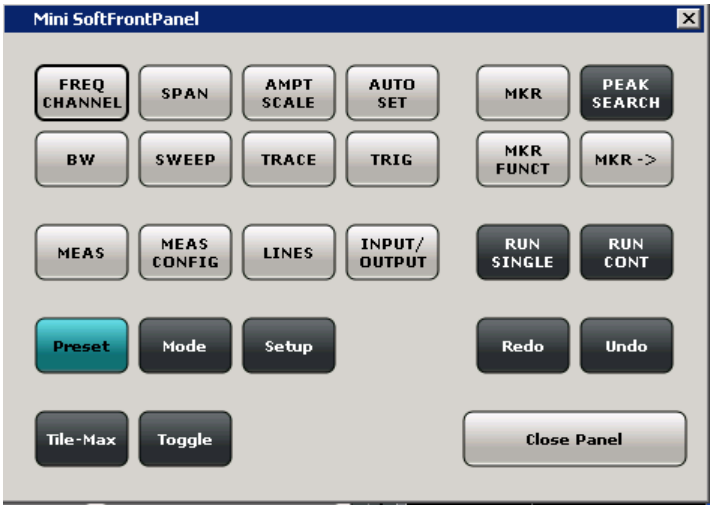
To activate or deactivate the front panel temporarily, press the F6 key on the external keyboard (if available) or the remote computer.

For more information see chapter 10.5.7, "How to Work with the Soft Front Panels", on page 210.

Remote command:
`SYSTem:DISPlay:FPANel[:STATe]` on page 406

Mini Front Panel
If you require a front panel display but do not want to lose too much space for results in the display area, a mini front panel is available. The mini version displays only the main function hardkeys in a separate window in the display area.

This window can be closed automatically after pressing a key ("Auto Close" option), or remain open, as desired.



Note:
You can also activate the Mini Front Panel using the key combination "ALT + m" (be aware of the keyboard language defined in the operating system!). This is useful when you are working from a remote PC and the Front Panel function is not active.

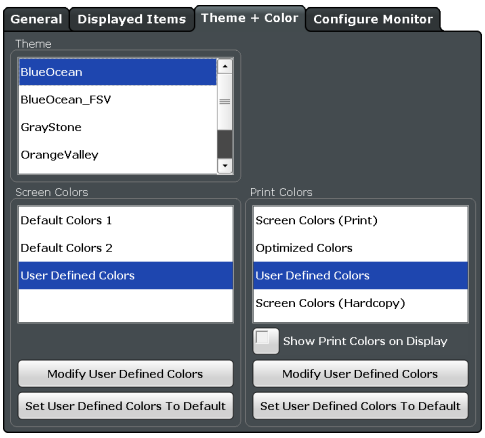
Remote command:
`SYSTem:DISPlay:FPANel[:STATe]` on page 406

10.3.3 Display Theme and Colors

Access: SETUP > "Display" > "Theme + Color"

You can configure the used colors and styles of display elements on the screen.

For step-by-step instructions see chapter 10.5.6, "How to Configure the Colors for Display and Printing", on page 209.



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Print colors 204
Showing Print Colors on Display 204
Modifying User-Defined Color Assignments 205

└ Selecting the Object....205
└ Predefined Colors....205
└ Preview....205
Defining User-specific Colors....205
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Theme
The theme defines the colors and style used to display softkeys and other screen objects.

The default theme is "BlueOcean".

Remote command:
`DISPlay:THEMe:SELect` on page 408

Screen colors
Two different color sets are provided by the instrument, a third user-defined set can be configured.

The default color schemes provide optimum visibility of all screen objects when regarding the screen from above or below. Default setting is "Default Colors 1".

If "User Defined Colors" is selected, a user-defined color set can be defined (see "Defining User-specific Colors" on page 205).

Remote command:
`DISPlay:CMAP<item>:DEFault<colors>` on page 407

Print colors
Defines the color settings used for printout. In addition to the predefined settings, a user-defined color set can be configured (see "Defining User-specific Colors" on page 205).

If "Show Print Colors on Display" is activated, the currently selected print colors are displayed as a preview for your selection.

Optimized Colors	Selects an optimized color setting for the printout to improve the visibility of the colors (default setting). Trace 1 is blue, trace 2 black, trace 3 green, and the markers are turquoise. The background is always printed in white and the grid in black.
Screen Colors (Print)	Selects the current screen colors for the printout. The background is always printed in white and the grid in black.
Screen Colors (Hardcopy)	Selects the current screen colors without any changes for a hardcopy.
User Defined Colors	Selects the user-defined color setting.

Remote command:
`HCOPy:CMAP<item>:DEFault<colors>` on page 387

Showing Print Colors on Display
Temporarily shows the currently selected print colors on the screen display. This function can be used as a preview for printing.

Modifying User-Defined Color Assignments

You can configure the colors used to display and print individual screen objects according to your specific requirements.

The colors are configured in the (identical) "Screen Color Setup"/"Printer Color Setup" dialog boxes.

Selecting the Object ← Modifying User-Defined Color Assignments

Selects the object for which the color is to be defined. Colors can be defined for the following objects:

- Background
- Grid
- Individual traces
- Display lines
- Limit lines and check results
- Markers and marker information

Remote command:
Each object is assigned to a specific suffix of the CMAP commands, see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

Predefined Colors ← Modifying User-Defined Color Assignments

Displays the available colors from the predefined color set that can be used for the selected object.

Remote command:
`HCOPy:CMAP<item>:PDEFined` on page 388

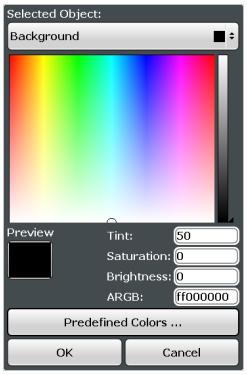
Preview ← Modifying User-Defined Color Assignments

Indicates the currently selected color that will be used for the selected object.

Defining User-specific Colors

In addition to the colors in the predefined color set you can configure a user-specific color to be used for the selected object.

When you select "Userdefined Colors", the set of predefined colors is replaced by a color palette and color configuration settings.



The color palette allows you to select the color directly. The color settings allow you to define values for tint, saturation and brightness.

Remote command:
`HCOPy:CMAP<item>:HSL` on page 388

Restoring the User Settings to Default Colors
In addition to the predefined color settings, a user-defined setting can be configured. By default, the same settings as defined in "Default Colors 1" are used. They can then be modified according to user-specific requirements (see "Modifying User-Defined Color Assignments" on page 205).

The "Set to Default" function restores the original default settings for the user-defined color set. You can select which of the three default settings are restored.

Remote command:
`DISPlay:CMAP<item>:PDEFined` on page 408

10.4 External Monitor Settings

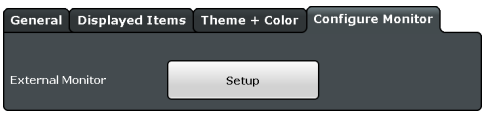
Access: SETUP > "Display" > "Configure Monitor"

You can connect an external monitor (or projector) to the DVI or DISPLAY PORT connector on the instrument's rear panel (see the R&S FSWP Getting Started manual).

Screen resolution and format

The touchscreen of the R&S FSWP is calibrated for a 16:10 format. If you connect a monitor or projector using a different format (e.g. 4:3), the calibration will not be correct and the screen will not react to your touch actions properly.

The touchscreen has a screen resolution of 1280x800 pixels. Most external monitors have a higher screen resolution. If the screen resolution of the monitor is set higher than the instrument's resolution, the application window uses an area of 1280x800 pixels on the monitor display. For full screen display, adjust the monitor's screen resolution.



Setup.....207

Setup
Opens the standard Windows configuration dialog box to configure the display devices to be used

10.5 How to Configure the Basic Instrument Settings

The following step-by-step instructions demonstrate how to configure the basic instrument settings. For details on individual functions and settings see chapter 10.2, "General Instrument Settings", on page 181.

The remote commands required to perform these tasks are described in chapter 10.2, "General Instrument Settings", on page 181.

10.5.1 How to Perform a Self-test

The self-test does not need to be repeated every time the instrument is switched on. It is only necessary when instrument malfunction is suspected.

Operating temperature
Before performing this functional test, make sure that the instrument has reached its operating temperature (for details, refer to the data sheet).

1. Press the SETUP key.
2. Press the "Service" softkey.
3. Press the "Self-test" softkey.

   Once the instrument modules have been checked successfully, a message is displayed.

10.5.2 How to Align the Instrument

Operating temperature
Before performing this functional test, make sure that the instrument has reached its operating temperature (for details, refer to the data sheet).

To perform a self-alignment

1. Press the SETUP key.
2. Select the "Alignment" softkey.
3. Select the "Start Self-alignment" button.
4. To abort the self-alignment process, select the "Abort Self-alignment" button.

   Once the system correction values have been calculated successfully, a message is displayed.

To display the alignment results again later

- Press the SETUP key.
- Press the "Alignment" softkey.

10.5.3 How to Align the Touchscreen

To align the touchscreen

1. Press the SETUP key.
2. Select the "Alignment" softkey.
3. Select "Touchscreen Alignment".

   A blinking cross appears in the lower left corner of the screen.
4. Touch and hold the blinking cross until it stops blinking.
   Repeat this action for the crosses in the other corners.

10.5.4 How to Install an R&S FSWP Option

Additional options for the R&S FSWP can be enabled using a license key. To obtain the license key, consult your sales representative. You need the device ID and serial number of your instrument to get a license key (see chapter 10.2.3, "System Configuration Settings", on page 186). No additional installation is required.

10.5.5 How to Update the Instrument Firmware

1. Download the update package from the Rohde&Schwarz website and store it on a memory stick, on the instrument, or on a server network drive that can be accessed by the instrument.
2. **NOTICE!** Stop measurement. The firmware update must not be performed during a running measurement.

If a measurement is running, stop it by pressing the highlighted RUN CONT or RUN SINGLE key.

3. Press the SETUP key.
4. Select the "Firmware Update" tab.
5. In the file selection dialog box select the `FSWPSetup*.exe` file.
6. Select "Install" to start the update.
7. After the firmware update, the R&S FSWP reboots automatically.
8. Depending on the previous firmware version, a reconfiguration of the hardware might be required during the first startup of the firmware. The reconfiguration starts automatically, and a message box informs you about the process. When the reconfiguration has finished, the instrument again reboots automatically.

   Note: Do not switch off the instrument during the reconfiguration process!

   Now the firmware update is complete. It is recommended that you perform a self-alignment after the update (see chapter 10.5.2, "How to Align the Instrument", on page 207).

10.5.6 How to Configure the Colors for Display and Printing

You can configure the style and colors with which various screen objects are displayed or printed.

To select a color set

1. Press the SETUP key and select the "Display" softkey.
2. Select the "Theme + Color" tab.
3. In the "Screen Colors" area, select a predefined set of colors to be used for screen display, or select "User Defined Colors" to configure the color set yourself.
4. In the "Print Colors" area, select a predefined set of colors to be used for printing screenshots, or select "User Defined Colors" to configure the color set yourself. Activate the "Show Print Colors on Display" option to see a preview of the print colors.

To configure a user-defined color set

1. In the "Theme + Color" tab of the "Display" dialog box select "User Defined Colors" either for the screen or the print colors.
2. Select "Modify User Color".

   The "Screen Color Setup" dialog box is opened.
3. From the "Selected Object" list, select the object to which you want to assign a color.

4. Select a color from the "Predefined Colors" or select the "Userdefined Colors..." button to define a different color.

   The "Preview" area indicates the currently selected color.

5. To assign a user-specific color to the selected object, do one of the following:
   - Select the color from the palette.
   - Enter values for the "Tint", "Saturation", and "Brightness".
     Note: In the continuous color spectrum ("Tint") red is represented by 0% and blue by 100%.
   - Enter an "ARGB" value in hexadecimal format.

6. Select the next object to which you want to assign a color from the "Selected Object" list and assign a color as described.
   Repeat these steps until all objects you want to configure have been assigned a color.

7. Select "OK" to close the dialog box and apply the colors to the assigned objects.

10.5.7 How to Work with the Soft Front Panels

Basic operation with the soft front panels is identical to normal operation, except for the following aspects:

To activate a key, select the key on the touchscreen.

To simulate the use of the rotary knob, use the additional keys displayed between the keypad and the arrow keys:

Icon	Function
	Turn left
	Enter
	Turn right

Mini Front Panel

The Mini Front Panel provides only the hardkeys on the touchscreen, in order to operate the R&S FSWP via an external monitor or remote desktop.

By default, the "Auto close" option is activated and the Mini Front Panel window closes automatically after you select a key. This is useful if you only require the Mini Front Panel display occassionally to press a single function key.

If you want the window to remain open, deactivate the "Auto close" option. You can close the window manually by selecting "Close Panel" or the key combination ALT + M (be aware of the keyboard language defined in the operating system!).

To display the soft front panel or mini front panel

1. Press the SETUP key and select the "Display" softkey.

2. Select the "Displayed Items" tab.
3. Select "Front Panel: On" or "Mini Front Panel: On".

To activate or deactivate the front panel temporarily, press the F6 key on the external keyboard (if available) or on the remote computer.

11 Network and Remote Operation

In addition to working with the R&S FSWP interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC. Various methods for remote control are supported:

- Connecting the instrument to a (LAN) network
- Using the LXI browser interface in a LAN network
- Using the Windows Remote Desktop application in a LAN network
- Connecting a PC via the GPIB interface

How to configure the remote control interfaces is described in chapter 11.4, "How to Set Up a Network and Remote Control", on page 258.

- Remote Control Basics 212
- The IECWIN Tool 249
- Network and Remote Control Settings 250
- How to Set Up a Network and Remote Control 258

11.1 Remote Control Basics

Basic information on operating an instrument via remote control is provided here. This information applies to all applications and operating modes on the R&S FSWP.

11.1.1 Remote Control Interfaces and Protocols

The instrument supports different interfaces and protocols for remote control. The following table gives an overview.

Table 11-1: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string	Remarks

Local Area Network (LAN)	• **HiSLIP** High-Speed LAN Instrument Protocol (IVI-6.1)
	`TCPIP::host address::hislip0[::INSTR]`
	• **VXI-11**
	`TCPIP::host address::inst0[::INSTR]`
	Library: VISA
	• **socket communication** (Raw Ethernet, simple Telnet)
	`TCPIP::host address[::LAN device name]::<port>::SOCKET`
	Library: VISA or socketcontroller
		A LAN connector is located on the rear panel of the instrument.
		The interface is based on TCP/IP and supports various protocols.
		For a description of the protocols refer to:
		VXI-11 Protocol
		HiSLIP Protocol
		Socket Communication

GPIB (IEC/IEEE Bus Interface)	VISA*) address string: `GPIB::primary address[::INSTR]` (no secondary address)	A GPIB bus interface according to the IEC 625.1/IEEE 488.1 standard is located on the rear panel of the instrument. For a description of the interface refer to 11.1.1.2 GPIB Interface (IEC 625/IEEE 418 Bus Interface).

Interface	Protocols, VISA*) address string	Remarks
USB	VISA*) address string: `USB::<vendor ID>::<product_ID>::<serial_number>[::INSTR]`	USB connectors are located on the front and rear panel of the instrument. For a description of the interface refer to 11.1.1.3 USB Interface.
*) VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control using the indicated interfaces. (See also chapter 11.1.3, "VISA Libraries", on page 219).		

Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.

11.1.1.1 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols. The network card can be operated with the following interfaces:

- 10 Mbit/s Ethernet IEEE 802.3
- 100 Mbit/s Ethernet IEEE 802.3u
- 1Gbit/s Ethernet IEEE 802.3ab

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. They are connected using a commercial RJ45 cable (shielded or unshielded twisted pair category 5). The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and the VISA program library must be installed on the controller.

VISA library

Instrument access is usually achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI, GPIB, LAN or USB function calls and thus makes the transport interface transparent for the user. See chapter 11.1.3, "VISA Libraries", on page 219 for details.

The R&S FSWP supports various LAN protocols such as LXI, RSIB, raw socket or the newer HiSLIP protocol.

IP address

Only the IP address or a valid DNS host name is required to set up the connection. The host address is part of the "VISA resource string" used by the programs to identify and control the instrument.

The VISA resource string has the form:

```
TCPIP::host address[::LAN device name][::INSTR]
```

or

`TCPIP::host address::port::SOCKET`

where:

- **TCPIP** designates the network protocol used
- **host address** is the IP address or host name of the device
- **LAN device name** defines the protocol and the instance number of a sub-instrument;
  - `inst0` selects the VXI-11 protocol (default)
  - `hislip0` selects the newer HiSLIP protocol
- **INSTR** indicates the instrument resource class (optional)
- **port** determines the used port number
- **SOCKET** indicates the raw network socket resource class

Example:

- Instrument has the IP address *192.1.2.3*; the valid resource string using VXI-11 protocol is:
  `TCPIP::192.1.2.3::INSTR`
- The DNS host name is *FSWP-123456*; the valid resource string using HiSLIP is:
  `TCPIP::FSWP-123456::hislip0`
- A raw socket connection can be established using:
  `TCPIP::192.1.2.3::5025::SOCKET`

Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by means of the resource string.

For details on configuring the LAN connection, see chapter 11.4.1, "How to Configure a Network", on page 258.

- VXI-11 Protocol....214
- HiSLIP Protocol....214
- Socket Communication....215
- LXI Web Browser Interface....215

VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

HiSLIP Protocol

The HiSLIP (**Hi**gh **S**peed **L**AN **I**nstrument **P**rotocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses

two TCP sockets for a single connection - one for fast data transfer, the other for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of firewalls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks

Note that HiSLIP data is sent to the device using the "fire and forget" method with immediate return, as opposed to VXI-11, where each operation is blocked until a VXI-11 device handshake returns. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the instrument has finished or started the requested command, but is delivered to the TCP/IP buffers.

For more information see also the application note: 1MA208: Fast Remote Instrument Control with HiSLIP.

Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred to as "Raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side. It is available by default on all operating systems.

The simplest way to establish socket communication is to use the built-in telnet program. The telnet program is part of every operating system and supports a communication with the software on a command-by-command basis. For more convenience and to enable automation by means of programs, user-defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All R&S FSWP use port number 5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

LXI Web Browser Interface

LAN eXtensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB. The LXI browser interface allows for easy configuration of the LAN and remote control of the R&S FSWP without additional installation requirements.

The instrument's LXI web browser interface works correctly with all W3C compliant browsers.

Via the LXI browser interface to the R&S FSWP you can control the instrument remotely from another PC. Manual instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available. Using this feature, several users can access *and operate* the R&S FSWP simultaneously. This is useful for troubleshooting or training purposes.

For details see chapter 11.4.1.4, "How to Configure the LAN Using the LXI Web Browser Interface", on page 262 and chapter 11.4.5, "How to Control the R&S FSWP via the Web Browser Interface", on page 268.

If you do not want other users in the LAN to be able to access and operate the R&S FSWP you can deactivate this function.

See chapter 11.4.6, "How to Deactivate the Web Browser Interface", on page 269.

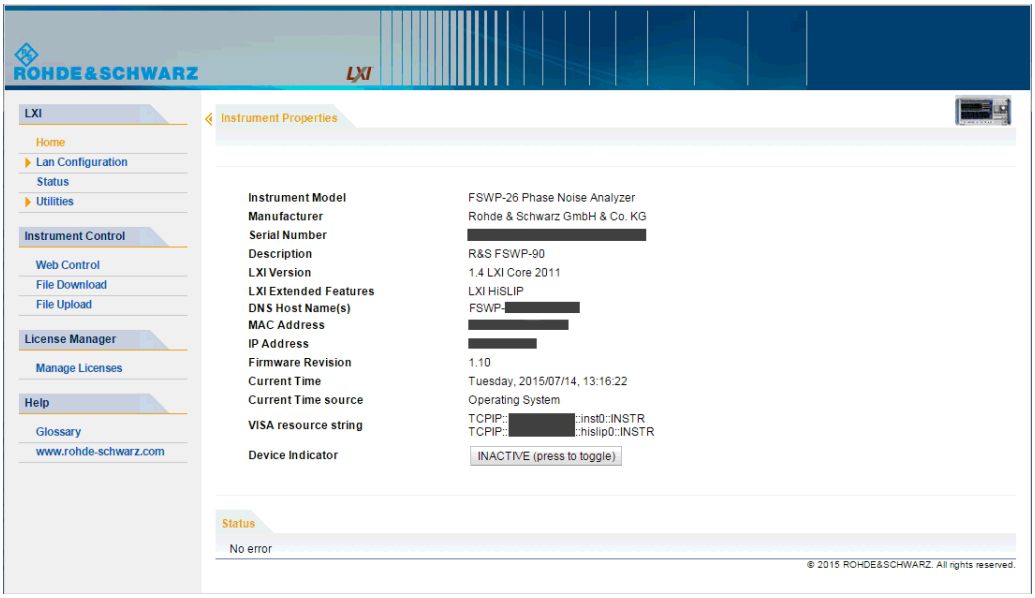
Restrictions

Only user accounts with administrator rights can make use of the LXI functionality. For details see chapter 1.2.3, "Login", on page 18.

To display the LXI web browser interface

► Type the instrument's host name or IP address in the address field of the browser on your PC, for example "http://10.113.10.203".

The instrument home page (welcome page) opens.



The navigation pane of the browser interface contains the following elements:

- "LXI"
  - "Home" opens the instrument home page.

The home page displays the device information required by the LXI standard, including the VISA resource string in read-only format.
The "Device Indicator" button allows you to physically identify the instrument. This is useful if you have several instruments and want to know which instrument the LXI home page belongs to. To identify the instrument, activate the "Device Indicator". Then check the "LAN Status" indicator of the instruments.

  - "Lan Configuration" allows you to configure LAN parameters and to initiate a ping.
    (See "Ping Client" on page 264.)
    (See
  - "Status" displays information about the LXI status of the instrument.
  - "Utilities" provides access to the LXI event log functionality required by the LXI standard.

- "Instrument Control"
  - "Web Control" provides remote access to the instrument via VNC (no installation required). Manual instrument controls are available via the front panel simulation.
  - "File Download" downloads files from the instrument.
  - "File Upload" uploads files to the instrument.

  (See chapter 11.4.5, "How to Control the R&S FSWP via the Web Browser Interface", on page 268.)
- "License Manager"
  - "Manage Licenses" allows you to install or uninstall license keys and to activate, register or unregister licenses.
- "Help"
  - "Glossary" explains terms related to the LXI standard.
  - "www.rohde-schwarz.com" opens the Rohde & Schwarz home page.

11.1.1.2 GPIB Interface (IEC 625/IEEE 418 Bus Interface)

A GPIB interface is integrated on the rear panel of the instrument.

By connecting a PC to the R&S FSWP via the GPIB connection you can send remote commands to control and operate the instrument.

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller. The controller must address the instrument with the GPIB bus address (see chapter 11.4.1.5, "How to Change the GPIB Instrument Address", on page 265). You can set the GPIB address and the ID response string. The GPIB language is set as SCPI by default and cannot be changed for the R&S FSWP.

Notes and Conditions

In connection with the GPIB interface, note the following:

- Up to 15 instruments can be connected

- The total cable length is restricted to a maximum of 15 m or 2 m times the number of devices, whichever is less; the cable lenth between two instruments should not exceed 2 m.
- A wired "OR"-connection is used if several instruments are connected in parallel.
- Any connected IEC-bus cables should be terminated by an instrument or controller.

11.1.1.3 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

USB address

The used USB address string is:

```
USB::<vendor ID>::<product ID>::<serial number>[::INSTR]
```

where:

- <vendor ID> is the vendor ID for Rohde & Schwarz (0x0AAD)
- <product ID> is the product ID for the Rohde & Schwarz instrument
- <serial number> is the individual serial number on the rear of the instrument

Table 11-2: Product IDs for R&S FSWP

Instrument model	Product ID
FSWP8	11E
FSWP26	11F

Example:

```
USB::0x0AAD::0x0011F::100001::INSTR
```

0x0AAD is the vendor ID for Rohde&Schwarz

0x0011F is the product ID for the R&S FSWP26

100001 is the serial number of the particular instrument

11.1.2 SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The R&S FSWP supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

11.1.3 VISA Libraries

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN or TCP/IP, USB, ...) is selected at initialization time by means of the channel–specific address string ("VISA resource string") indicated in table 11-1, or by an appropriately defined VISA alias (short name).

A VISA installation is a prerequisite for remote control using the following interfaces:

- chapter 11.1.1.1, "LAN Interface", on page 213
- chapter 11.1.1.2, "GPIB Interface (IEC 625/IEEE 418 Bus Interface)", on page 217
- chapter 11.1.1.3, "USB Interface", on page 218

For more information about VISA refer to the user documentation.

11.1.4 Messages

The messages transferred on the data lines are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.
- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in chapter 11.1.5, "SCPI Command Structure", on page 220. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  – Commands
  – Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
  – **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.
  – **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.

- According to their definition in standards:
  - **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self-test.
  - **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI confirmed" in the command reference chapters. Commands without this SCPI label are device-specific; however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

11.1.5 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

11.1.5.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

11.1.5.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument.

For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HCOPy:DEVice:COLor <Boolean>`
- `HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HCOPy[:IMMediate]`
- `HCOPy:ITEM:ALL`
- `HCOPy:ITEM:LABel <string>`
- `HCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to chapter 11.1.5.3, "SCPI Parameters", on page 223.

Example:

Definition:`HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

Special characters

|	**Parameters**
	A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
	Example:
	Definition:`HCOPy:PAGE:ORIentation LANDscape | PORTrait`
	Command `HCOP:PAGE:ORI LAND` specifies landscape orientation
	Command `HCOP:PAGE:ORI PORT` specifies portrait orientation
	Mnemonics
	A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
	Example:
	Definition`SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
	The two following commands with identical meaning can be created:
	`SENS:BAND:RES 1`
	`SENS:BWID:RES 1`

[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. **Example**: `HCOPy[:IMMediate]` `HCOP:IMM` is equivalent to `HCOP`

{ }	Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
	Example: `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`
	The following are valid commands:
	`SENS:LIST:FREQ 10`
	`SENS:LIST:FREQ 10,20`
	`SENS:LIST:FREQ 10,20,30,40`

11.1.5.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENS:FREQ:STOP 1.5GHz` = `SENS:FREQ:STOP 1.5E9`

Units

For physical quantities, the unit can be entered. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

```
HCOP:PAGE:SCAL 90PCT
```

Special numeric values

The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.

- **MIN/MAX**
  MINimum and MAXimum denote the minimum and maximum value.
- **DEF**
  DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP/DOWN**
  UP, DOWN increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.
- **INF/NINF**

INFinity, Negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.

- **NAN**
  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?, Response: 3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: `HCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"` or `HCOP:ITEM:LABel 'Test1'`

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`FORMat:READings:DATA #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

11.1.5.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
' ' "	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. • Binary: #B10110 • Octal: #O7612 • Hexa: #HF3A7 • Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

11.1.5.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>
- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

```
MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL
```

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

```
HCOP:ITEM ALL;:HCOP:IMM
```

This command line contains two commands. Both commands are part of the `HCOP` command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

```
HCOP:ITEM ALL;IMM
```

A new command line always begins with the complete path.

Example:

```
HCOP:ITEM ALL
HCOP:IMM
```

11.1.5.6 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: `HCOP:PAGE:ORI?`, Response: `LAND`
- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: `SENSe:FREQuency:STOP? MAX`, Response: `3.5E9`

- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` in the previous example stands for 3.5 GHz.
- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).
  Example:
  Setting command: `HCOPy:DEV:COL ON`
  Query: `HCOPy:DEV:COL?`
  Response: `1`
- Text (character data) is returned in a short form.
  Example:
  Setting command: `HCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`

11.1.6 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands.
- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100;:FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

As a general rule, send commands and queries in different program messages.

Example: Overlapping command with *OPC

The instrument implements `INITiate[:IMMediate]` as an overlapped command. Assuming that `INITiate[:IMMediate]` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a sweep and, after some time, setting the `OPC` bit in the `ESR`:

```
INIT; *OPC.
```

Sending the following commands still initiates a sweep:

```
INIT; *OPC; *CLS
```

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

11.1.6.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands *OPC, *OPC? or *WAI can be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the corresponding action to occur.

Table 11-3: Synchronization using *OPC, *OPC? and *WAI

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization using *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes only little time to process. The two synchronization techniques simply block overlapped execution of the command.

For time consuming overlapped commands it is usually desirable to allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

***OPC with a service request**

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1

2. Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.
3. Send the overlapped command with *OPC
4. Wait for a service request

   The service request indicates that the overlapped command has finished.

***OPC? with a service request**

1. Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.
2. Send the overlapped command with *OPC?
3. Wait for a service request

   The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Send the overlapped command without *OPC, *OPC? or *WAI
3. Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

   A return value (LSB) of 1 indicates that the overlapped command has finished.

***OPC? with short timeout**

1. Send the overlapped command without *OPC, *OPC? or *WAI
2. Poll the operation complete state periodically (by means of a timer) using the sequence: <short timeout>; *OPC?
3. A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.
4. Reset timeout to former value
5. Clear the error queue with `SYStem:ERRor?` to remove the "-410, Query interrupted" entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI.

A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

11.1.7 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. Both can be queried via GPIB bus or LAN interface (`STATus...` commands, see chapter 12.10, "Using the Status Register", on page 421).

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- Structure of a SCPI Status Register 232
- Contents of the Status Registers 234
- Application of the Status Reporting System 245
- Reset Values of the Status Reporting System 247

11.1.7.1 Hierarchy of Status Registers

As shown in the following figure, the status information is of hierarchical structure.

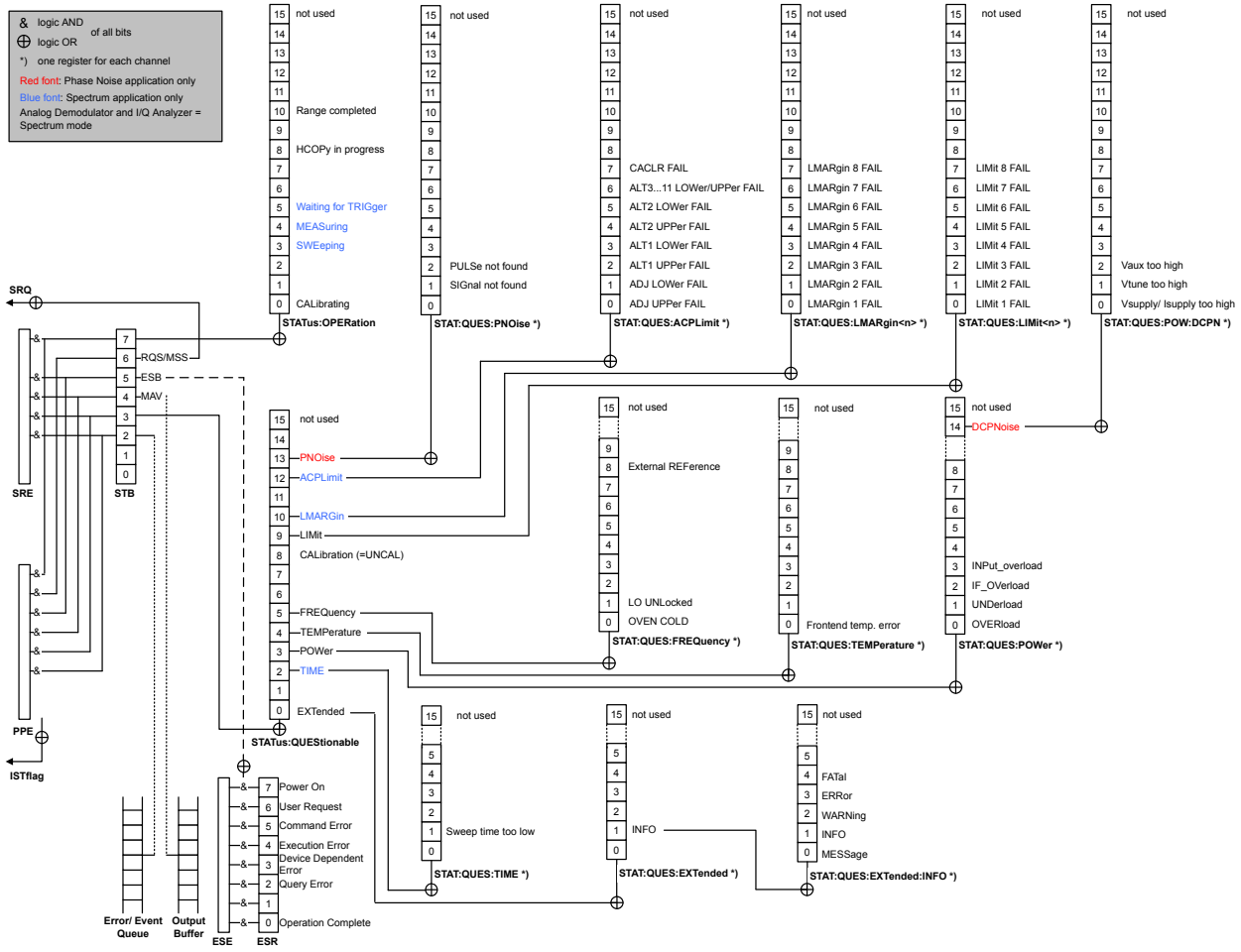

Fig. 11-1: Graphical overview of the R&S FSWP status registers hierarchy

- **STB, SRE**
  The STatus Byte (`STB`) register and its associated mask register Service Request Enable (`SRE`) form the highest level of the status reporting system. The `STB` pro-

vides a rough overview of the instrument status, collecting the information of the lower-level registers.

- **ESR, SCPI registers**
  The STB receives its information from the following registers:
  – The Event Status Register (ESR) with the associated mask register standard Event Status Enable (ESE).
  – The STATus:OPERation and STATus:QUEStionable registers which are defined by SCPI and contain detailed information on the instrument.
- **IST, PPE**
  The IST flag ("Individual STatus"), like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills the same function for the IST flag as the SRE for the service request.
- **Output buffer**
  The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in the overview.

All status registers have the same internal structure.

SRE, ESE

The service request enable register SRE can be used as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be used as the ENABle part of the ESR.

11.1.7.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.

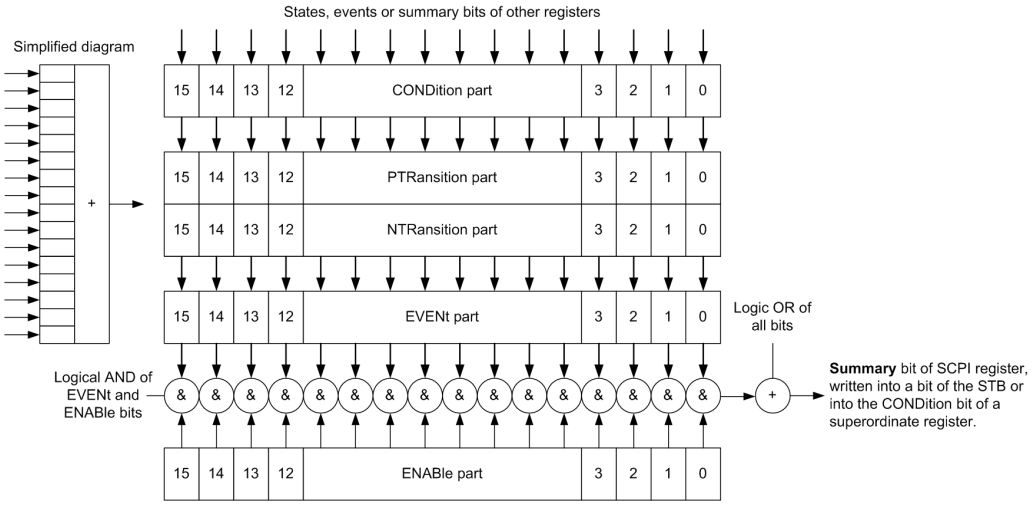
States, events or summary bits of other registers
Simplified diagram
15 14 13 12 CONDition part 3 2 1 0
15 14 13 12 PTRansition part 3 2 1 0
15 14 13 12 NTRansition part 3 2 1 0
15 14 13 12 EVENt part 3 2 1 0
Logic OR of all bits
Logical AND of EVENt and ENABle bits
Summary bit of SCPI register, written into a bit of the STB or into the CONDition bit of a superordinate register.
15 14 13 12 ENABle part 3 2 1 0

Fig. 11-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**
  The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.
- **PTRansition / NTRansition**
  The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.
  The **Positive-TRansition** part acts as a transition filter. When a bit of the `CONDition` part is changed from 0 to 1, the associated `PTR` bit decides whether the `EVENt` bit is set to 1.
  – PTR bit =1: the `EVENt` bit is set.
  – PTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
  The **Negative-TRansition** part also acts as a transition filter. When a bit of the `CONDition` part is changed from 1 to 0, the associated `NTR` bit decides whether the `EVENt` bit is set to 1.
  – NTR bit =1: the `EVENt` bit is set.
  – NTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
- **EVENt**
  The `EVENt` part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be

read by the user. Reading the register clears it. This part is often equated with the entire register.

- **ENABle**
  The ENABle part determines whether the associated EVENt bit contributes to the sum bit (see below). Each bit of the EVENt part is "ANDed" with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').
  ENABle bit = 0: the associated EVENt bit does not contribute to the sum bit
  ENABle bit = 1: if the associated EVENt bit is "1", the sum bit is set to "1" as well.
  This part can be written into and read by the user as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

11.1.7.3 Contents of the Status Registers

In the following sections, the contents of the status registers are described in more detail.

- Status Byte (STB) and Service Request Enable Register (SRE)....234
- IST Flag and Parallel Poll Enable Register (PPE)....235
- Event Status Register (ESR) and Event Status Enable Register (ESE)....236
- STATus:OPERation Register....236
- STATus:QUEStionable Register....237
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- STATus:QUEStionable:EXTended Register....239
- STATus:QUEStionable:EXTended:INFO Register....240
- STATus:QUEStionable:FREQuency Register....240
- STATus:QUEStionable:LIMit Register....241
- STATus:QUEStionable:LMARgin Register....242
- STATus:QUEStionable:POWer Register....242
- STATus:QUEStionable:POWer:DCPNoise....243
- STATus:QUEStionable:PNOise....244
- STATus:QUEStionable:TEMPerature Register....244
- STATus:QUEStionable:TIMe Register....244

Status Byte (STB) and Service Request Enable Register (SRE)

The STatus Byte (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy.

The STB is read using the command *STB? or a serial poll.

The STatus Byte (STB) is linked to the Service Request Enable (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command *SRE and read using the command *SRE?.

Table 11-4: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit The bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the STATus:QUEStionable status register.
4	MAV bit (message available) The bit is set if a message is available in the output queue which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	STATus:OPERation status register summary bit The bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the STATus:OPERation status register.

IST Flag and Parallel Poll Enable Register (PPE)

As with the SRQ, the IST flag combines the entire status information in a single bit. It can be read by means of a parallel poll (see "Parallel Poll" on page 246) or using the command *IST?.

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are "ANDed" with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the "ORing" of all results. The PPE can be set using commands *PRE and read using command *PRE?.

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the `EVENt` part of a SCPI register. The event status register can be read out using command *ESR?.

The ESE corresponds to the `ENABle` part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command `*ESE` and read using the command `*ESE?`.

Table 11-5: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

The `STATus:OPERation` register contains information on current activities of the R&S FSWP. It also contains information on activities that have been executed since the last read out.

Table 11-6: Meaning of the bits used in the STATus:OPERation register

Bit No.	Meaning
0	`CALibrating` This bit is set as long as the instrument is performing a calibration.
1-2	Not used

Bit No.	Meaning
3	SWEeping Sweep is being performed in base unit (applications are not considered); identical to bit 4 Available in the optional Spectrum application.
4	MEASuring Measurement is being performed in base unit (applications are not considered); identical to bit 3 Available in the optional Spectrum application.
5	Waiting for TRIgger Instrument is ready to trigger and waiting for trigger signal. Available in the optional Spectrum application.
6-7	Not used
8	HardCOPy in progress This bit is set while the instrument is printing a hardcopy.
9	Not used
10	Range completed This bit is set when a range in the sweep list has been completed if "Stop after Range" has been activated. Available in the optional Spectrum application.
11-14	Not used
15	This bit is always 0.

STATus:QUEStionable Register

The STATus:QUEStionable register contains information on instrument states that do not meet the specifications.

You can read out the register with STAT:QUES:COND or STAT:QUES:EVEN.

The STATus:QUEStionable register "sums up" the information from all subregisters (e.g. bit 2 sums up the information for all STATus:QUEStionable:TIMe registers). For some subregisters, there may be separate registers for each active channel. Thus, if a status bit in the STATus:QUEStionable register indicates an error, the error may have occurred in any of the channel-specific subregisters. In this case, you must check the subregister of each channel to determine which channel caused the error. By default, querying the status of a subregister always returns the result for the currently selected channel.

Table 11-7: Meaning of the bits used in the STATus:QUEStionable register

Bit No.	Meaning
0 - 1	Unused
2	TIMe This bit is set if a time error occurs in any of the active channels. The STATus:QUEStionable:TIMe Register provides more information on the error type. Available in the optional Spectrum application.
3	POWer This bit is set if the measured power level in any of the active channels is questionable. The STATus:QUEStionable:POWer Register provides more information on the error type.
4	TEMPerature This bit is set if the temperature is questionable.
5	FREQuency This bit is set if there is anything wrong with the frequency of the local oscillator or the reference frequency in any of the active channels. The STATus:QUEStionable:FREQuency Register provides more information on the error type.
6 - 7	Unused
8	CALibration This bit is set if the R&S FSWP is unaligned ("UNCAL" display)
9	LIMit This bit is set if a limit value is violated in any of the active channels in any window. The STATus:QUEStionable:LIMit Register provides more information on the error type.
10	LMARgin This bit is set if a margin is violated in any of the active channels in any window. The STATus:QUEStionable:LMARgin Register provides more information on the error type. Available in the optional Spectrum application.
11	SYNC (device-specific) This bit is set if the R&S FSWP is not synchronized to the signal that is applied. The R&S FSWP is not synchronized if the results deviate too much from the expected value during premeasurements
12	ACPLimit This bit is set if a limit during ACLR measurements is violated in any of the active channels. The STATus:QUEStionable:ACPLimit Register provides more information on the error type. Available in the optional Spectrum application.
13	PNOise This bit is set if an event occurs in the Phase Noise measurement. The "STATus:QUEStionable:PNOise" on page 244 provides more information on the event type.
15	This bit is always 0.

STATus:QUEStionable:ACPLimit Register

Available for the Spectrum application.

The STATus:QUEStionable:ACPLimit register contains information about the results of a limit check during ACLR measurements. A separate ACPLimit register exists for each active channel.

You can read out the register with `STATus:QUEStionable:ACPLimit:CONDition?` or `STATus:QUEStionable:ACPLimit[:EVENt]?`

Table 11-8: Meaning of the bits used in the STATus:QUEStionable:ACPLimit register

Bit No.	Meaning
0	ADJ UPPer FAIL This bit is set if the limit is exceeded in the **upper adjacent** channel
1	ADJ LOWer FAIL This bit is set if the limit is exceeded in the **lower adjacent** channel.
2	ALT1 UPPer FAIL This bit is set if the limit is exceeded in the **upper 1st alternate** channel.
3	ALT1 LOWer FAIL This bit is set if the limit is exceeded in the **lower 1st alternate** channel.
4	ALT2 UPPer FAIL This bit is set if the limit is exceeded in the **upper 2nd alternate** channel.
5	ALT2 LOWer FAIL This bit is set if the limit is exceeded in the **lower 2nd alternate** channel.
6	ALT3 … 11 LOWer/UPPer FAIL This bit is set if the limit is exceeded in one of the lower or upper alternate channels 3 … 11.
7	CACLR FAIL This bit is set if the CACLR limit is exceeded in one of the gap channels.
8	GAP ACLR FAIL This bit is set if the ACLR limit is exceeded in one of the gap channels.
9 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:EXTended Register

The `STATus:QUEStionable:EXTended` register contains further status information not covered by the other status registers of the R&S FSWP. A separate `EXTended` register exists for each active channel.

You can read out the register with `STATus:QUEStionable:EXTended:CONDition?` or `STATus:QUEStionable:EXTended[:EVENt]?`

Table 11-9: Meaning of the bits used in the STATus:QUEStionable:EXTended register

Bit No.	Meaning
0	not used
1	INFO This bit is set if a status message is available for the application. Which type of message occurred is indicated in the STATus:QUEStionable:EXTended:INFO Register.
2 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:EXTended:INFO Register

The `STATus:QUEStionable:EXTended:INFO` register contains information on the type of messages that occur during operation of the R&S FSWP. A separate `INFO` register exists for each active channel.

You can read out the register with `STATus:QUEStionable:EXTended:INFO:CONDition?` or `STATus:QUEStionable:EXTended:INFO[:EVENt]?`. You can query all messages that occur for a specific channel using the command `SYSTem:ERRor:EXTended?` on page 416.

Table 11-10: Meaning of the bits used in the STATus:QUEStionable:EXTended:INFO register

Bit No.	Meaning
0	MESSage This bit is set if event or state has occurred that may lead to an error during further operation.
1	INFO This bit is set if an informational status message is available for the application.
2	WARNing This bit is set if an irregular situation occurs during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
3	ERRor This bit is set if an error occurs during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be completed correctly.
4	FATal This bit is set if a serious error occurs in the application and regular operation is no longer possible.
5 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:FREQuency Register

The STATus:QUEStionable:FREQuency register contains information about the condition of the local oscillator and the reference frequency. A separate frequency register exists for each active channel.

You can read out the register with `STATus:QUEStionable:FREQuency:CONDition?` or `STATus:QUEStionable:FREQuency[:EVENt]?`.

Table 11-11: Meaning of the bits used in the STATus:QUEStionable:FREQuency register

Bit No.	Meaning
0	OVEN COLD This bit is set if the reference oscillator has not yet attained its operating temperature. "OCXO" is displayed.
1	LO UNLocked This bit is set if the local oscillator no longer locks. "LOUNL" is displayed.
2 to 7	Not used
8	EXTernalREFerence This bit is set if you have selected an external reference oscillator but did not connect a useable external reference source. In that case the synthesizer can not lock. The frequency in all probability is not accurate.
9 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:LIMit Register

The STATus:QUEStionable:LIMit register contains information about the results of a limit check when you are working with limit lines.

A separate LIMit register exists for each active channel and for each window.

You can read out the register with `STATus:QUEStionable:LIMit<n>:CONDition?` or `STATus:QUEStionable:LIMit<n>[:EVENt]?`.

Table 11-12: Meaning of the bits used in the STATus:QUEStionable:LIMit register

Bit No.	Meaning
0	LIMit 1 FAIL This bit is set if limit line 1 is violated.
1	LIMit 2 FAIL This bit is set if limit line 2 is violated.
2	LIMit 3 FAIL This bit is set if limit line 3 is violated.
3	LIMit 4 FAIL This bit is set if limit line 4 is violated.
4	LIMit 5 FAIL This bit is set if limit line 5 is violated.
5	LIMit 6 FAIL This bit is set if limit line 6 is violated.
6	LIMit 7 FAIL This bit is set if limit line 7 is violated.

Bit No.	Meaning
7	LIMit 8 FAIL This bit is set if limit line 8 is violated.
8 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:LMARgin Register

This register contains information about the observance of limit margins.

A separate LMARgin register exists for each active channel and for each window.

It can be read using the commands
`STATus:QUEStionable:LMARgin:CONDition?` and
`STATus:QUEStionable:LMARgin[:EVENt]?`.

Table 11-13: Meaning of the bits used in the STATus:QUEStionable:LMARgin register

Bit No.	Meaning
0	LMARgin 1 FAIL This bit is set if limit margin 1 is violated.
1	LMARgin 2 FAIL This bit is set if limit margin 2 is violated.
2	LMARgin 3 FAIL This bit is set if limit margin 3 is violated.
3	LMARgin 4 FAIL This bit is set if limit margin 4 is violated.
4	LMARgin 5 FAIL This bit is set if limit margin 5 is violated.
5	LMARgin 6 FAIL This bit is set if limit margin 6 is violated.
6	LMARgin 7 FAIL This bit is set if limit margin 7 is violated.
7	LMARgin 8 FAIL This bit is set if limit margin 8 is violated.
8 to 14	Not used
15	This bit is always 0.

STATus:QUEStionable:POWer Register

The `STATus:QUEStionable:POWer` register contains information about possible overload situations that may occur during operation of the R&S FSWP. A separate power register exists for each active channel.

You can read out the register with `STATus:QUEStionable:POWer:CONDition?` or `STATus:QUEStionable:POWer[:EVENt]?`

Table 11-14: Meaning of the bits used in the STATus:QUEStionable:POWer register

Bit No.	Meaning
0	OVERload This bit is set if an overload occurs at the RF input, causing signal distortion but not yet causing damage to the device. The R&S FSWP displays the keyword "RF OVLD".
1	UNDerload This bit is set if an underload occurs at the RF input. The R&S FSWP displays the keyword "UNLD".
2	IF_OVerload This bit is set if an overload occurs in the IF path. The R&S FSWP displays the keyword "IF OVLD".
3	Input Overload This bit is set if the signal level at the RF input connector exceeds the maximum. The RF input is disconnected from the input mixer to protect the device. In order to re-enable measurement, decrease the level at the RF input connector and reconnect the RF input to the mixer input. The R&S FSWP displays the keyword "INPUT OVLD". (Available with the optional Spectrum application.)
4 to 13	Unused
14	DCPNoise This bit is set in case of an event at the DC power supply. For more information see "STATus:QUEStionable:POWer:DCPNoise" on page 243.
15	This bit is always 0.

STATus:QUEStionable:POWer:DCPNoise

Available for the Phase Noise application.

The STATus:QUEStionable:POWer:DCPNoise register contains information about the state and condition of the DC power supply. A separate POWer:DCPNoise register exists for each active channel.

You can read out the register with `STATus:QUEStionable:POWer:DCPNoise:CONDition?` or `STATus:QUEStionable:POWer:DCPNoise[:EVENt]?`.

Table 11-15: Meaning of the bits used in the STATus:QUEStionable:POWer:DCPNoise register

Bit No.	Meaning
0	V_{supply} / I_{supply} This bit is set if something is wrong with the voltage or current supply.
1	V_{tune} This bit is set if something is wrong with the tuning voltage supply.
2	V_{aux} This bit is set if something is wrong with the auxiliary voltage supply.

Bit No.	Meaning
3 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:PNOise

Available for the Phase Noise application.

The STATus:QUEStionable:PNOise register contains information about the state and condition of the phase noise application. A separate PNOise register exists for each active channel.

You can read out the register with `STATus:QUEStionable:PNOise:CONDition?` on page 423 or `STATus:QUEStionable:PNOise[:EVENt]?` on page 423.

Table 11-16: Meaning of the bits used in the STATus:QUEStionable:PNOise register

Bit No.	Meaning
0	Unused
1	SIGNal not found This bit is set when no signal could be found during the signal search.
2	PULSe not found This bit is set when no pulse could be found during the signal search of pulsed phase noise measurements.
3 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:TEMPerature Register

The STATus:QUEStionable:TEMPerature register contains information about possible temperature deviations that may occur during operation of the R&S FSWP. A separate temperature register exists for each active channel.

You can read out the register with `STATus:QUEStionable:TEMPerature:CONDition?` or `STATus:QUEStionable:TEMPerature[:EVENt]?`

Table 11-17: Meaning of the bits used in the STATus:QUEStionable:TEMPerature register

Bit No.	Meaning
0	This bit is set if the frontend temperature sensor deviates by a certain degree from the self-alignment temperature. During warmup, this bit is always 0. For details see "Temperature check" on page 181.
1 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:TIMe Register

Available for the Spectrum application.

The STATus:QUEStionable:TIMe register contains information about possible time errors that may occur during operation of the R&S FSWP. A separate time register exists for each active channel.

Table 11-18: Meaning of the bits used in the STATus:QUEStionable:TIMe register

Bit No.	Meaning
0	not used
1	Sweep time too low This bit is set if the sweep time is too low and thus calibration fails. Note: the STATus:QUEStionable bit for CALibration is not affected by this error.
2 to 14	Unused
15	This bit is always 0.

11.1.7.4 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

- **Service request** (SRQ) initiated by the instrument
- **Serial poll** of all devices in the bus system, initiated by the controller in order to find out who sent a SRQ and why
- **Parallel poll** of all devices
- Query of a **specific instrument status** by means of commands
- Query of the **error queue**

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. A service request is a request from an instrument for information, advice or treatment by the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from figure 11-1, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The ENABle parts of the status registers can be set such that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request effectively, all bits should be set to "1" in enable registers SRE and ESE.

The service request is the only possibility for the instrument to become active on its own. Each controller program should cause the instrument to initiate a service request if errors occur. The program should react appropriately to the service request.

Use of the command *OPC to generate an SRQ at the end of a sweep

1. `CALL InstrWrite(analyzer, "*ESE 1")` 'Set bit 0 in the ESE (Operation Complete)

2. `CALL InstrWrite(analyzer, "*SRE 32")` 'Set bit 5 in the SRE (ESB)
3. `CALL InstrWrite(analyzer, "*INIT;*OPC")` ' Generate an SRQ after operation complete

   After its settings have been completed, the instrument generates an SRQ.

Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller using a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1".

In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a Parallel Poll Enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 as well. This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll using the command `*IST?`.

The instrument first has to be set for the parallel poll using the command `PPC`. This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using `PPE`.

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the controller has sent a service request. To this effect, SRE and PPE must be set to the same value.

Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

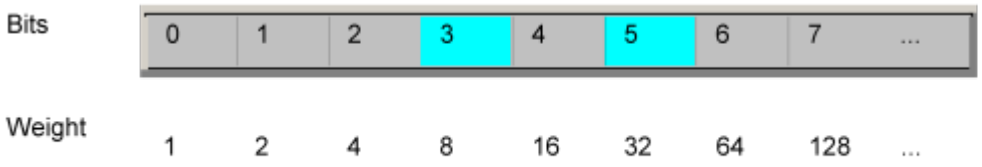
- The common commands `*ESR?`, `*IDN?`, `*IST?`, `*STB?` query the higher-level registers.
- The commands of the `STATus` system query the SCPI registers (`STATus:QUEStionable...`)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Decimal representation of a bit pattern

The STB and ESR registers contain 8 bits, the SCPI registers 16 bits. The contents of a status register are specified and transferred as a single decimal number. To make this possible, each bit is assigned a weighted value. The decimal number is calculated as the sum of the weighted values of all bits in the register that are set to 1.



Example:

The decimal value 40 = 32 + 8 indicates that bits no. 3 and 5 in the status register (e.g. the `QUEStionable` status summary bit and the `ESB` bit in the `STatus` Byte) are set.

Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?` or `SYSTem:ERRor:ALL?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

11.1.7.5 Reset Values of the Status Reporting System

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTem:PRESet`, influence the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 11-19: Resetting the status reporting system

Event	**Switching on supply voltage** **Power-On-Status-Clear**		**DCL, SDC** **(Device Clear, Selected Device Clear)**	***RST or SYS-Tem:PRE-Set**	**STA-Tus:PRE-Set**	***CLS**
Effect	**0**	**1**				
Clear STB, ESR	-	yes	-	-	-	yes
Clear SRE, ESE	-	yes	-	-	-	-

Event	Switching on supply voltage Power-On-Status-Clear		DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYS-Tem:PRE-Set	STA-Tus:PRE-Set	*CLS
Effect	0	1				
Clear PPE	-	yes	-	-	-	-
Clear EVENt parts of the registers	-	yes	-	-	-	yes
Clear ENABle parts of all OPERation and QUEStionable registers; Fill ENABle parts of all other registers with "1".	-	yes	-	-	yes	-
Fill PTRansition parts with "1"; Clear NTRansition parts	-	yes	-	-	yes	-
Clear error queue	yes	yes	-	-	-	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	-	-	-
1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.						

11.1.8 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence

As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also chapter 11.1.6.1, "Preventing Overlapping Execution", on page 229).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

11.2 The IECWIN Tool

The R&S FSWP is delivered with *IECWIN* installed, an auxiliary tool provided free of charge by R&S. IECWIN is a program to send SCPI commands to a measuring instrument either interactively or from a command script.

The R&S IECWIN32 tool is provided free of charge. The functionality may change in a future version without notice.

IECWIN offers the following features:

- Connection to instrument via several interfaces/protocols (GPIB, VISA, named pipe (if IECWIN is run on the instrument itself), RSIB)
- Interactive command entry
- Browsing available commands on the instrument
- Error checking following every command
- Execution of command scripts
- Storing binary data to a file
- Reading binary data from a file
- Generation of a log file

For command scripts, IECWIN offers the following features:

- Synchronization with the instrument on every command
- Checking expected result for query commands (as string or numeric value)
- Checking for expected errors codes
- Optional pause on error
- Nested command scripts
- Single step mode
- Conditional execution, based on the *IDN and *OPT strings

You can use the IECWIN to try out the programming examples provided in the R&S FSWP User Manuals.

Starting IECWIN

IECWIN is available from the Windows task bar on the R&S FSWP, or by executing the following file:

```
C:\Program Files (x86)\Rohde-Schwarz\FSWP\<1.10 or higher>\
iecwin32.exe
```

You can also copy the program to any Windows PC or laptop. Simply copy the `iecwin32.exe`, `iecwin.chm` and `rsib32.dll` files from the location above to the same folder on the target computer.

When the tool is started, a "Connection settings" dialog box is displayed. Define the connection from the computer the IECWIN tool is installed on to the R&S FSWP you want to control. If you are using the tool directly on the R&S FSWP, you can use an NT Pipe (COM Parser) connection, which requires no further configuration. For help on setting up other connection types, check the tool's online help (by clicking the "Help" button in the dialog box).

The IECWIN offers an online help with extensive information on how to work with the tool.

11.3 Network and Remote Control Settings

The network and remote control settings are defined in the "Network + Remote" dialog box which is displayed when you press the SETUP key and then select "Network + Remote".

Network settings in secure user mode

Be sure to store all network settings before Secure User Mode is enabled; see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

If the currently stored network settings are not suitable, you must correct them each time you switch on the R&S FSWP in secure user mode, as the settings are not stored permanently in this case.

The remote commands required to define these settings are described in chapter 12.9.5, "Configuring Network and Remote Control", on page 410.

Step-by-step instructions are provided in chapter 11.4, "How to Set Up a Network and Remote Control", on page 258.

- General Network Settings 251
- GPIB Settings 252
- LXI Settings 255
- Remote Errors 257

11.3.1 General Network Settings

The R&S FSWP can be operated in a local area network (LAN), for example to control the instrument from a remote PC or use a network printer.

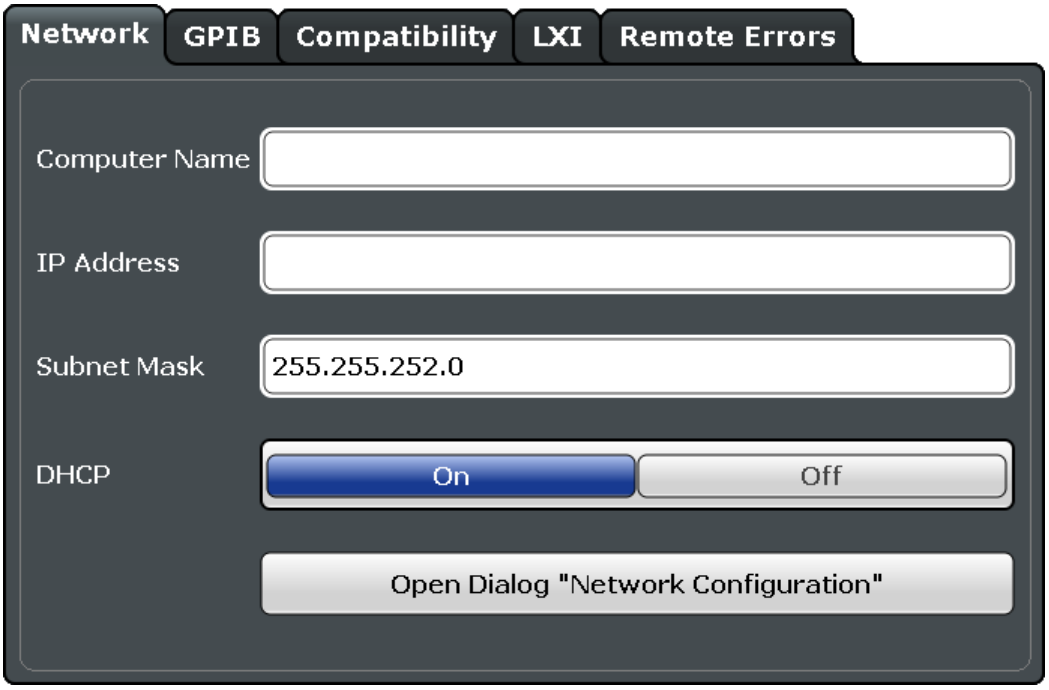
The general network settings are defined in the "Network" tab of the "Network + Remote" dialog box.

NOTICE

Risk of network problems

All parameters can be edited here; however, beware that changing the computer name has major effects in a network.

For details, see chapter 11.4, "How to Set Up a Network and Remote Control", on page 258.



Computer Name....251
IP Address....252
Subnet Mask....252
DHCP....252
Network Configuration....252

Computer Name

Each instrument is delivered with an assigned computer name, but this name can be changed. The naming conventions of Windows apply. If too many characters and/or numbers are entered, an error message is displayed in the status line.

The default instrument name is a non-case-sensitive string with the following syntax:

<Type><variant>-<serial_number>

For example `FSWP26-123456`

The serial number can be found on the rear panel of the instrument. It is the third part of the device ID printed on the bar code sticker:

IP Address
Defines the IP address. The TCP/IP protocol is preinstalled with the IP address 10.0.0.10. If the DHCP server is available ("DHCP On"), the setting is read-only.

The IP address consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

Subnet Mask
Defines the subnet mask. The TCP/IP protocol is preinstalled with the subnet mask 255.255.255.0. If the DHCP server is available ("DHCP On"), this setting is read-only.

The subnet mask consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

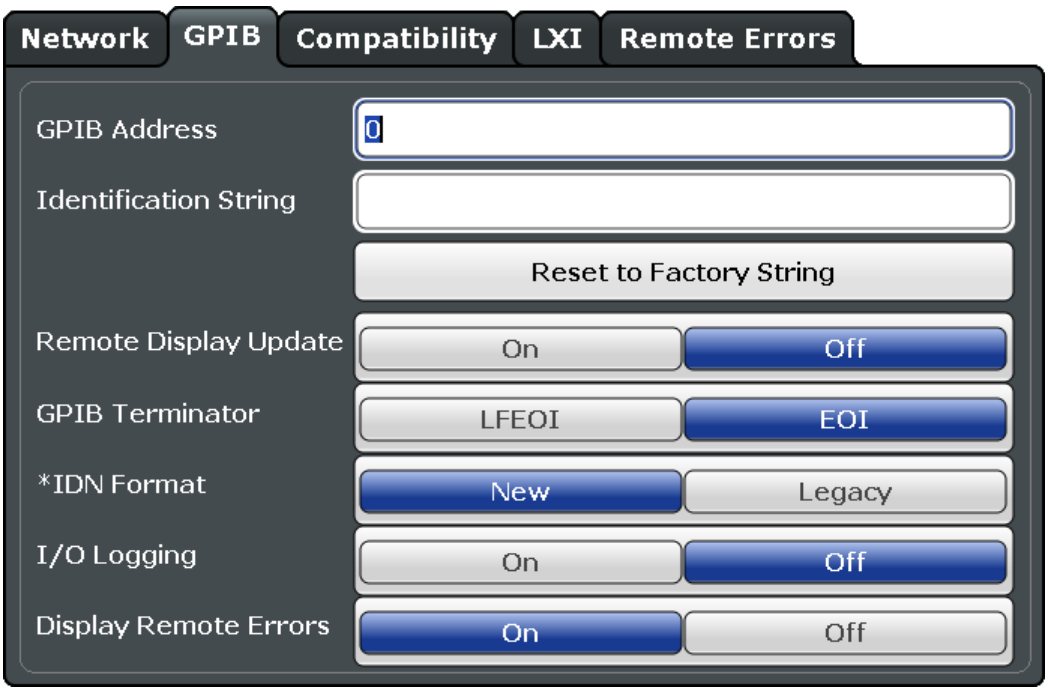
DHCP
Switches between DHCP server available (On) or not available (Off). If a DHCP server is available in the network, the IP address and subnet mask of the instrument are obtained automatically from the DHCP server.

Network Configuration
Opens the standard Windows "Network Configuration" dialog box for further configuration.

11.3.2 GPIB Settings

Alternatively to connecting the R&S FSWP to a LAN, the GPIB interface can be used to connect a remote PC. For details see chapter 11.1.1.2, "GPIB Interface (IEC 625/ IEEE 418 Bus Interface)", on page 217).

The GPIB settings are defined in the "GPIB" tab of the "Network + Remote" dialog box.



GPIB Address 253
Identification String 253
Reset to Factory String 253
Remote Display Update 254
GPIB Terminator 254
*IDN Format 254
I/O Logging 254
Display Remote Errors 254

GPIB Address
Defines the GPIB address. Values from 0 to 30 are allowed. The default address is 20.

Remote command:
`SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 410

Identification String
Defines the identification string for the R&S FSWP which is provided as a response to the `*IDN?` query. Maximum 36 characters are allowed.

Remote command:
`SYSTem:IDENtify[:STRing]` on page 412

Reset to Factory String
Restores the default identification string. Each R&S FSWP has a unique ID according to the following syntax:

Rohde&Schwarz,FSWP,<Unique number>

Remote command:
`SYSTem:IDENtify:FACTory` on page 412

Remote Display Update
Defines whether the display of the R&S FSWP is updated when changing from manual operation to remote control.

Turning off the display update function improves performance during remote control.

Remote command:
`SYSTem:DISPlay:UPDate` on page 411

GPIB Terminator
Changes the GPIB receive terminator.

"LFEOI" According to the standard, the terminator in ASCII is <LF> and/or <EOI>.

"EOI" For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by using only the receive terminator `EOI`.

Remote command:
`SYSTem:COMMunicate:GPIB[:SELF]:RTERminator` on page 411

***IDN Format**
Defines the response format to the remote command `*IDN?` (see `*IDN?` on page 281). This function is intended for re-use of existing control programs together with the R&S FSWP.

"Leg" Legacy format, as in the R&S FSP/FSU/FSQ family.

"New" R&S FSWP format.

Remote command:
`SYSTem:FORMat:IDENt` on page 418

I/O Logging
Activates or deactivates the SCPI error log function. All remote control commands received by the R&S FSWP are recorded in the following log file:

`C:\R_S\instr\ScpiLogging\ScpiLog.txt`

Logging the commands may be extremely useful for debug purposes, e.g. in order to find misspelled keywords in control programs.

Remote command:
`SYSTem:CLOGging` on page 396

Display Remote Errors
Activates and deactivates the display of errors that occur during remote operation of the R&S FSWP. If activated, the R&S FSWP displays a message box at the bottom of the screen that contains the type of error and the command that caused the error.

The error message remains in place when you switch to "Local" mode. To close the message box, select the "Close" icon.

Only the most recent error is displayed in remote mode. However, in local mode, all errors that occurred during remote operation are listed in a separate tab of the "Network + Remote" dialog box (see chapter 11.3.4, "Remote Errors", on page 257).

Remote command:
`SYSTem:ERRor:DISPlay` on page 412
`SYSTem:ERRor:CLEar:REM` on page 411

11.3.3 LXI Settings

On the R&S FSWP the LXI Class C functionality is already installed and enabled; thus, the instrument can be accessed via any web browser (e.g. the Microsoft Internet Explorer) to perform the following tasks:

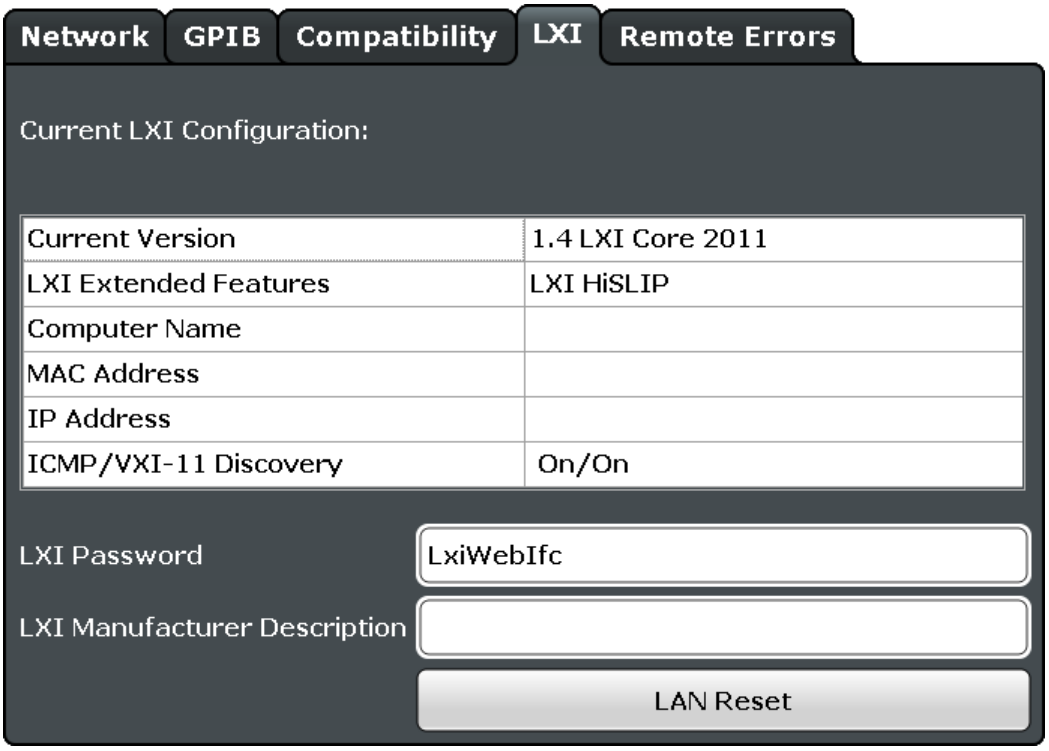
- modifying network configurations
- modifying device configurations
- monitoring connections from the device to other devices

The "LXI" tab of the "Network + Remote" dialog box provides basic LXI functions and information for the R&S FSWP.

Alternatively, you can change the LAN settings using the LXI Web browser interface.

For details see chapter 11.4.1.4, "How to Configure the LAN Using the LXI Web Browser Interface", on page 262.

Only user accounts with administrator rights are able to use LXI functionality.



Current LXI Configuration 256
LXI Password 256
LXI Manufacturer Description 256
LAN Reset 256

Current LXI Configuration
Displays the current LXI information from the R&S FSWP (read-only).

"Current version"	Current LXI version
"LXI Extended Features"	Detected LXI features, such as HiSlip (see "HiSLIP Protocol" on page 214)
"Computer name"	Name of the R&S FSWP as defined in the operating system (see also "Computer Name" on page 251)
"MAC address"	Media Access Control address (MAC address), a unique identifier for the network card in the R&S FSWP
"IP address"	IP address of the R&S FSWP as defined in the operating system (see also "IP Address" on page 252).
"ICMP"	Indicates whether the ping responder is active or not
"VXI-11 Discovery"	If enabled, connected devices are detected automatically using the VXI-11 protocol (see "VXI-11 Protocol" on page 214)

Remote command:
`SYSTem:LXI:INFo?` on page 412

LXI Password
Password for LAN configuration. The default password is *LxiWebIfc*.

Remote command:
`SYSTem:LXI:PASSword` on page 413

LXI Manufacturer Description
Instrument description of the R&S FSWP

Remote command:
`SYSTem:LXI:MDEScription` on page 413

LAN Reset
Resets the LAN configuration to its default settings (LCI function).

According to the LXI standard, an LCI must set the following parameters to a default state.

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
ICMP Ping	Enabled
Password for LAN configuration	LxiWebIfc

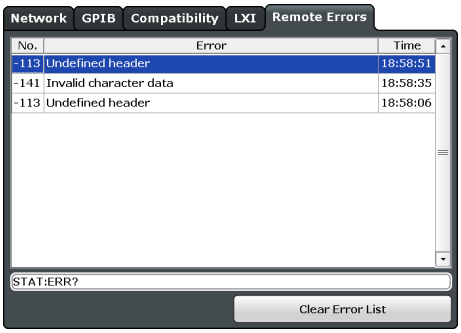
The LAN settings are configured in the "Network" tab of the "Network + Remote" dialog box or using the instrument's LXI Browser interface.

Remote command:
SYSTem:LXI:LANReset on page 413

11.3.4 Remote Errors

The error messages generated by the R&S FSWP during remote operation are displayed in the "Remote Errors " tab of the "Network + Remote" dialog box.

The messages are displayed in the order of their occurrence; the most recent messages are placed at the top of the list.



The most recent error message during remote operation can be displayed on the screen, see "Display Remote Errors" on page 254.

If the number of error messages exceeds the capacity of the error buffer, the oldest error message is removed before the newest one is inserted. To clear the message buffer use the "Clear Error List" button. It is automatically cleared when the R&S FSWP is shut down.

The following information is available:

No	Device-specific error code
Error	Brief description of the error
Date/Time	Time the message occurred

Remote command:

SYSTem:ERRor:LIST? on page 417

Clear Error List
Deletes the error message buffer for remote operation.

Note: The remote error list is automatically cleared when the R&S FSWP is shut down.

Remote command:
SYSTem:ERRor:CLEar:REM on page 411

11.4 How to Set Up a Network and Remote Control

NOTICE

Risk of network failure

Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

Remote operation

Remote operation of the instrument from a connected computer is possible using SCPI commands (see chapter 11.1.2, "SCPI (Standard Commands for Programmable Instruments)", on page 218). Sending remote commands requires the instrument to be configured in a LAN network or connected to a PC via the GPIB interface as described in chapter 11.4.1, "How to Configure a Network", on page 258.

Remote Desktop

In production test and measurement, a common requirement is central monitoring of the T&M instruments for remote maintenance and remote diagnostics. Equipped with the Remote Desktop software of Windows, the R&S FSWP ideally meets requirements for use in production. The computer that is used for remote operation is called "controller" here.

The following tasks can be performed using Remote Desktop:

- Access to the control functions via a virtual front panel (soft front panel)
- Printout of measurement results directly from the controller
- Storage of measured data on the controller's hard disk

This documentation provides basic instructions on setting up the Remote Desktop for the R&S FSWP. For details refer to the Microsoft Windows operating system documentation.

11.4.1 How to Configure a Network

A precondition for operating or monitoring the instrument remotely is that it is connected to a LAN network or a PC connected to the GPIB interface. This is described here.

Windows Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. Rohde & Schwarz highly recommends the use of the firewall on your instrument. R&S instruments are shipped with the Windows firewall enabled and preconfigured in such a way that all ports and connections for remote control are enabled. For more details on firewall configuration see the R&S White Paper "Malware Protection" (available at http://www.rohde-schwarz.com/appnote/1EF73) and the Microsoft Windows help system.

11.4.1.1 How to Connect the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

- A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol. An IP address has to be assigned to the instrument and the computer, see chapter 11.4.1.2, "How to Assign the IP Address", on page 259.
  Note: As the R&S FSWP uses a 1 GBit LAN, a crossover cable is not necessary (due to Auto-MDI(X) functionality).

► To establish a non-dedicated network connection, connect a commercial RJ-45 cable to one of the LAN ports.
To establish a dedicated connection, connect a (crossover) RJ-45 cable between the instrument and a single PC.

If the instrument is connected to the LAN, Windows automatically detects the network connection and activates the required drivers.

The network card can be operated with a 1 GBit Ethernet IEEE 802.3u interface.

11.4.1.2 How to Assign the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
- If the network does not support DHCP, or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

When a DHCP server is used, a new IP address may be assigned each time the PC is restarted. This address must first be determined on the PC itself. Thus, when using a DHCP server, it is recommended that you use the permanent computer name, which determines the address via the DNS server (see "Using a DNS server to determine the IP address" on page 261).

NOTICE

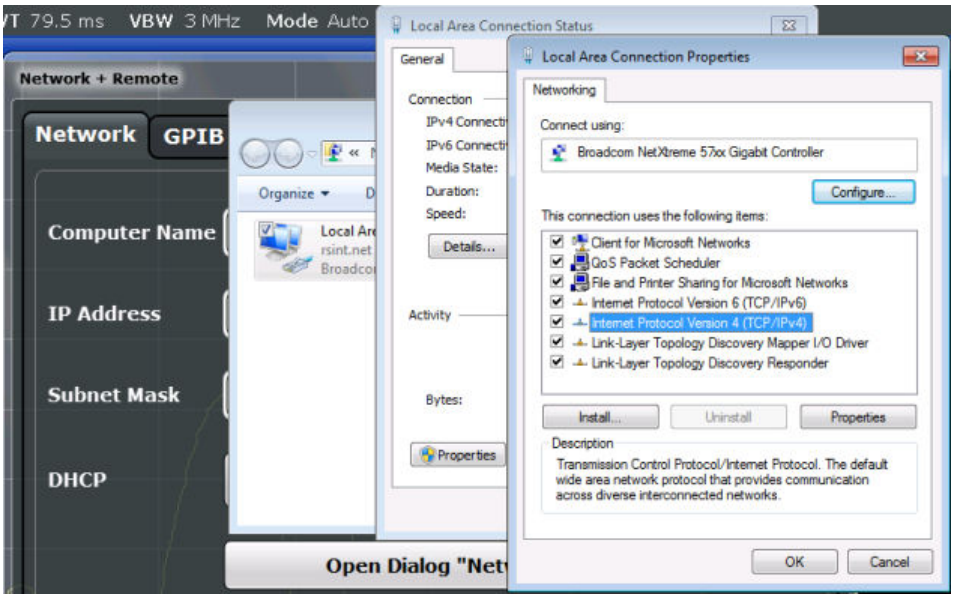
Risk of network errors

Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

Assigning the IP address on the R&S FSWP

1. Press the SETUP key.
2. Press the "Network + Remote" softkey.
3. Double-tap the "Local Area Connection" icon.
4. In the "Local Area Connection Status" dialog box, select the "Properties" button.

   The items used by the LAN connection are displayed.
5. Tap the entry named "Internet Protocol Version 4 (TCP/IPv4)" to highlight it.



6. Select the "Properties" button.

7. In the "Network + Remote" dialog, toggle the "DHCP On/Off" setting to the required mode.
   If DHCP is "Off", you must enter the IP address manually, as described in the following steps.
   Note: When DHCP is changed from "On" to "Off", the previously set IP address and subnet mask are retrieved.
   If DHCP is "On", the IP address of the DHCP server is obtained automatically. The configuration is saved, and you are prompted to restart the instrument. You can skip the remaining steps.
   Note: When a DHCP server is used, a new IP address may be assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, when using a DHCP server, it is recommended that you use the permanent computer name, which determines the address via the DNS server.
8. Enter the "IP Address", for example *10.0.0.10*. The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.
9. Enter the "Subnet Mask", for example *255.255.255.0*. The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.
10. Close the dialog box.

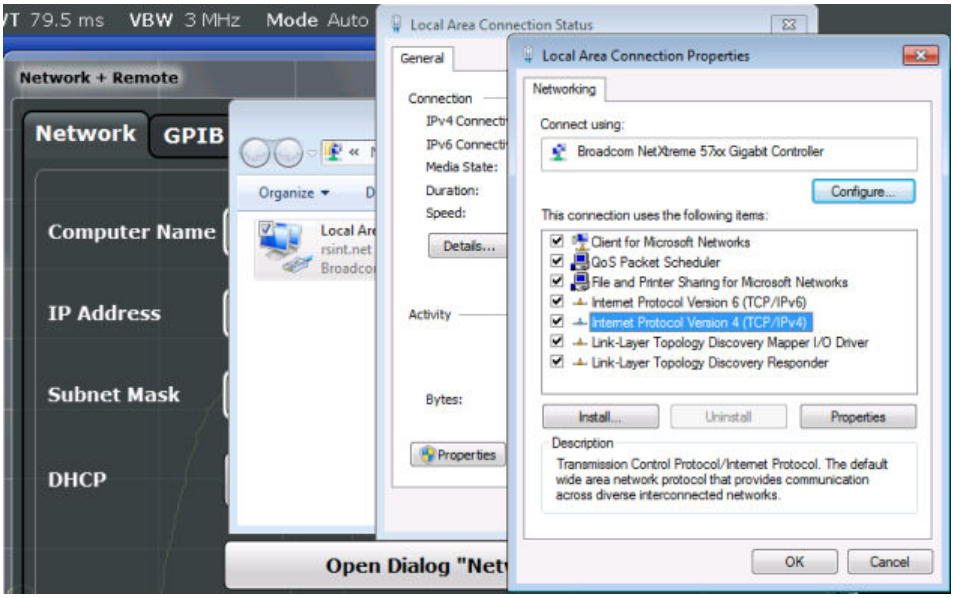
    If you have entered an invalid IP address or subnet mask, the message "out of range" is displayed in the status line. If the settings are correct, the configuration is saved, and you are prompted to restart the instrument.
11. Confirm the displayed message ("Yes" button) to restart the instrument.

Using a DNS server to determine the IP address

If a DNS server is configured on the R&S FSWP, the server can determine the current IP address for the connection using the permanent computer name.

1. Obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network (see chapter 11.4.1.3, "How to Change the Instrument Name", on page 262).
2. Press the SETUP key and then the "Network + Remote" softkey.
3. In the "Network" tab, select the "Open Dialog 'Network Connections'" button.
4. Double-tap the "Local Area Network" icon.
5. In the "Local Area Connection Status" dialog box, select the "Properties" button.

   The items used by the LAN connection are displayed.
6. Tap the entry named "Internet Protocol Version 4 (TCP/IPv4)" to highlight it.



7. Select the "Properties" button.
8. On the "General" tab, select "Use the following DNS server addresses" and enter your own DNS addresses.

   For more information refer to the Microsoft Windows operating system Help.

11.4.1.3 How to Change the Instrument Name

In a LAN that uses a DNS server (Domain Name System server), each PC or instrument connected in the LAN can be accessed via an unambiguous computer name instead of the IP address. The DNS server translates the host name to the IP address. This is especially useful when a DHCP server is used, as a new IP address may be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, but this name can be changed.

To change the instrument's computer name

1. Press the SETUP key and then the "Network + Remote" softkey.
   The current "Computer Name" is displayed in the "Network" tab.
2. Enter the new computer name and close the dialog box.

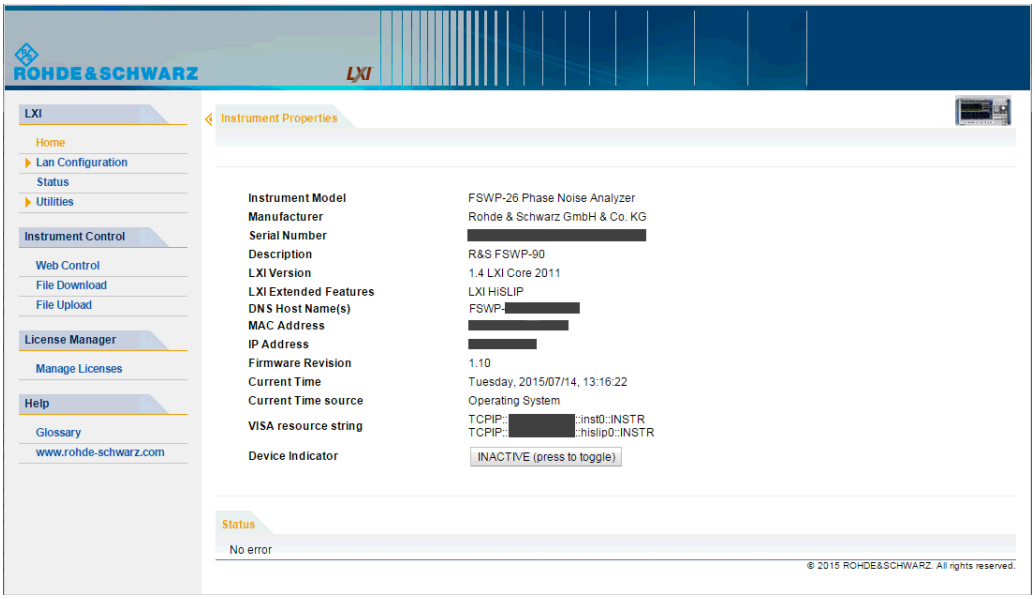
   The configuration is saved, and you are prompted to restart the instrument.
3. Confirm the displayed message ("Yes" button) to restart the instrument.

11.4.1.4 How to Configure the LAN Using the LXI Web Browser Interface

The instrument's LXI browser interface works correctly with all W3C compliant browsers.

► In the web browser, open the `http://<instrument-hostname>` or `http://<instrument-ip-address>` page, e.g. *http://10.113.10.203*.
The default password to change LAN configurations is *LxiWebIfc*.

The "Instrument Home Page" (welcome page) opens.



The instrument home page displays the device information required by the LXI standard including the VISA resource string in read-only format.

► Press the "Device Indicator" button on the "Instrument Home Page" to activate or deactivate the LXI status icon on the status bar of the R&S FSWP. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates an error, for example, that no LAN cable is connected. When a device is connecting to the instrument, the LXI logo blinks. The "Device Indicator" setting is not password-protected.

The most important control elements in the navigation pane of the browser interface are the following:

- "LAN Configuration" opens the menu with configuration pages.
- "Status" displays information about the LXI status of the instrument.
- "Help > Glossary" opens a document with a glossary of terms related to the LXI standard.

LAN Configuration

The LAN configuration consists of three parts:

- "IP configuration" provides all mandatory LAN parameters.
- "Advanced LAN Configuration" provides LAN settings that are not declared mandatory by the LXI standard.

- "Ping Client" provides the ping utility to verify the connection between the instrument and other devices.

IP Configuration

The "LAN Configuration > IP configuration" web page displays all mandatory LAN parameters and allows their modification.

For the manual configuration mode, the static IP address, subnet mask, and default gateway are used to configure the LAN. The automatic configuration mode uses DHCP server or Dynamic Link Local Addressing (Automatic IP) to obtain the instrument IP address.

Changing the LAN configuration is password-protected. The default password is *LxiWebIfc* (notice upper and lower case characters).

You can change the LXI password in the "Network + Remote" dialog box, see chapter 11.3.3, "LXI Settings", on page 255.

Advanced LAN Configuration

The "LAN Configuration > Advanced LAN Configuration" parameters are used as follows:

- The "Negotiation" configuration field provides different Ethernet speed and duplex mode settings. In general, the "Auto Detect" mode is sufficient.
- "ICMP Ping" must be enabled to use the ping utility.
- "VXI-11" is the protocol that is used to detect the instrument in the LAN. According to the standard, LXI devices must use VXI-11 to provide a detection mechanism; other additional detection mechanisms are permitted.
- mDNS and DNS-SD are two additional protocols: Multicast DNS and DNS Service Discovery. They are used for device communication in zero configuration networks working without DNS and DHCP

Ping Client

Ping is a utility that verifies the connection between the LXI-compliant instrument and another device. The ping command uses the `ICMP` echo request and echo reply packets to determine whether the LAN connection is functional. Ping is useful for diagnosing IP network or router failures. The ping utility is not password-protected.

To initiate a ping between the LXI-compliant instrument and a second connected device:

1. Enable "ICMP Ping" on the "Advanced LAN Configuration" page (enabled after an LCI).
2. Enter the IP address of the second device **without the ping command and without any further parameters** into the "Destination Address" field (e.g. *10.113.10.203*).
3. Select "Submit".

11.4.1.5 How to Change the GPIB Instrument Address

In order to operate the instrument via remote control, it must be addressed using the GPIB address. The remote control address is factory-set to 20, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

Setting the GPIB address

1. On the R&S FSWP, press the SETUP key.
2. Press the "Network + Remote" softkey.
3. In the "Network + Remote" dialog box, select the "GPIB" tab.
4. In the "GPIB Address" field, enter a value between 0 and 30.

Remote command:

```
SYST:COMM:GPIB:ADDR 18
```

11.4.2 How to Operate the Instrument Without a Network

To operate the instrument without a network connection either temporarily or permanently, no special measures are necessary. Microsoft Windows automatically detects the interruption of the network connection and does not set up the connection when the instrument is switched on.

If you are not prompted to enter the user name and password, proceed as described in chapter 11.4.3.3, "How to Activate or Deactivate the Automatic Login Mechanism", on page 267.

11.4.3 How to Log on to the Network

Microsoft Windows requires that users identify themselves by entering a user name and password in a login window. You can set up two types of user accounts, either an administrator account with unrestricted access to the computer/domain or a standard user account with limited access. The instrument provides an auto-login function for the administrator account, i.e. login with unrestricted access is carried out automatically in the background. By default, the user name for the administrator account is "Instrument", and the user name for the standard user account is "NormalUser". In both cases the initial password is "894129". You can change the password in Microsoft Windows for any user at any time. Some administrative tasks require administrator rights (e.g. firmware updates or the configuration of a LAN network).

Refer to chapter 10, "General Instrument Setup", on page 180 to find out which functions are affected.

At the same time you log on to the operating system, you are automatically logged on to the network. As a prerequisite, the user name and the password must be identical on the instrument and on the network.

11.4.3.1 How to Create Users

After the software for the network has been installed, the instrument issues an error message the next time it is switched on because there is no user named "instrument" (= default user ID for Windows automatic login) in the network. Thus, a matching user must be created in the R&S FSWP and in the network, the password must be adapted to the network password, and the automatic login mechanism must then be deactivated.

The network administrator is responsible for creating new users in the network. A new user can be created on the instrument using the "User Account" dialog box:

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. In the "Start" menu, select "Control Panel" and then select "User Accounts."
3. Select "Give other users access to this computer" and then "Add".
   The "Add New User" dialog box is displayed.
4. Enter the name of the new user in the text field and select "Next".
5. Define the level of access you want to allow the new user:
   - Select "Standard" to create an account with limited rights.
   - Select "Administrator" to create an account with administrator rights.

   Note: Full firmware functionality requires administrator rights.
6. Select the "Finish" button.
   The new user is created.

11.4.3.2 How to Change the User Password

After the new user has been created on the instrument, the password must be adapted to the network password. This is also done using the "User Accounts" dialog box.

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. Press CTRL + ALT + DELETE, then select "Change a password".
3. Enter the user account name.
4. Enter the old password.
5. Enter the new password in the upper text line and repeat it in the following line.
6. Press ENTER.
   The new password is now active.

11.4.3.3 How to Activate or Deactivate the Automatic Login Mechanism

Deactivating the automatic login mechanism

When shipped, the instrument is already configured to automatically log on under Microsoft Windows. To deactivate the automatic login mechanism, perform the following steps:

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG`.
3. Press the ENTER key to confirm.
   The automatic login mechanism is deactivated. The next time you switch on the instrument, you are prompted to enter your user name and password before the firmware is started.

Reactivating the automatic login mechanism

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command `C:\R_S\INSTR\USER\AUTOLOGIN.REG`.
3. Press the ENTER key to confirm.
   The automatic login mechanism is reactivated. It will be applied the next time the instrument is switched on.

11.4.4 How to Share Directories (only with Microsoft Networks)

Sharing directories makes data available for other users. This is only possible in Microsoft networks. Sharing is a property of a file or directory.

1. In the "Start" menu, select "Programs", "Accessories" and then select "Windows Explorer".
2. Select the desired folder with the right mouse button.
3. In the context menu, select "Sharing with > Specific people".
   The dialog box for sharing a directory is displayed.
4. Select a user from the list or add a new name and select the "Add" button.
5. Select the "Share" button.
6. Select "Done" to close the dialog box.
   The drive is shared and can be accessed by the selected users.

11.4.5 How to Control the R&S FSWP via the Web Browser Interface

Via the LXI browser interface to the R&S FSWP one or more users can control the instrument remotely from another PC without additional installation. Most instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

To access the R&S FSWP via the web browser interface

1. Start a web browser that supports html5 (W3C compliant).
2. Enter the IP address of the R&S FSWP in the browser's address bar.

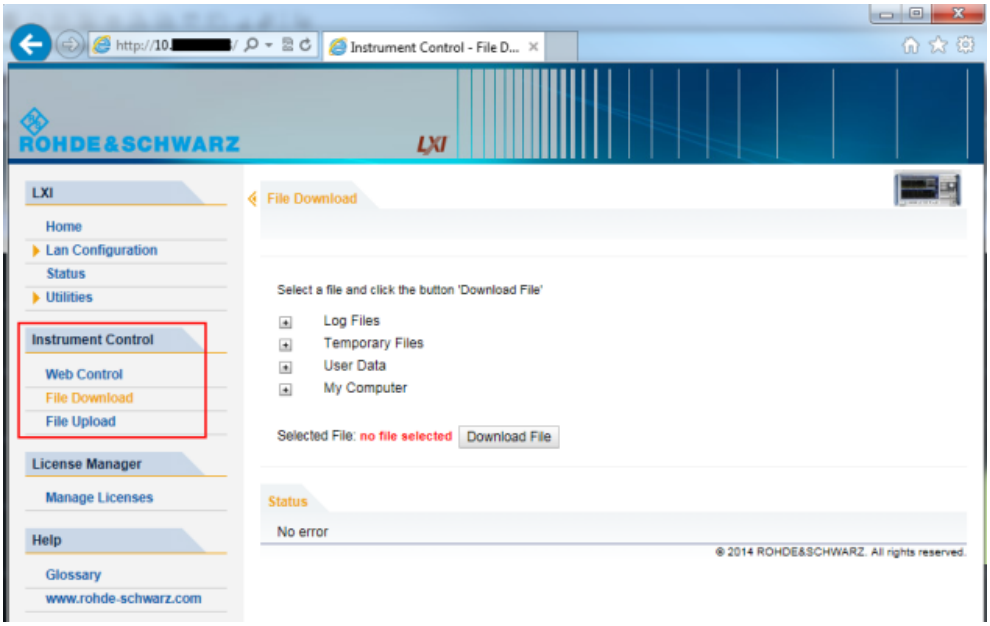
   The R&S FSWP's Welcome page is displayed.
3. In the navigation pane, select "Instrument Control > Web Control".

   The instrument's display is shown in a new browser window, with a software front panel displayed beside or below it.
4. Use the mouse cursor to access the functionality in the software front panel or in the display as you would directly on the instrument's front panel.

To exchange files with the R&S FSWP

You can download files, for example stored measurement data, from the R&S FSWP to the remote PC, or upload files, for example limit line definitions, from the PC to the R&S FSWP.

1. In the web browser, select the Welcome page window.
2. In the navigation pane, select "Instrument Control" > "File Upload" or "File Download".



The most commonly used folders on the instrument are displayed, for example those that contain user data, as well as the top-most `My Computer` folder, from which you can access all other folders on the instrument.

3. To download a file from the R&S FSWP, select the file from the displayed folders and then select "Download File".
4. To upload a file to the R&S FSWP:
   a) From the displayed folders in the web browser window, select the folder on the R&S FSWP to which you want to copy a file.
   b) Under "File to Upload", select "Browse" to open a file selection dialog box and select the required file on the PC.
   c) Select "Upload" to copy the file from the PC to the defined folder on the R&S FSWP.

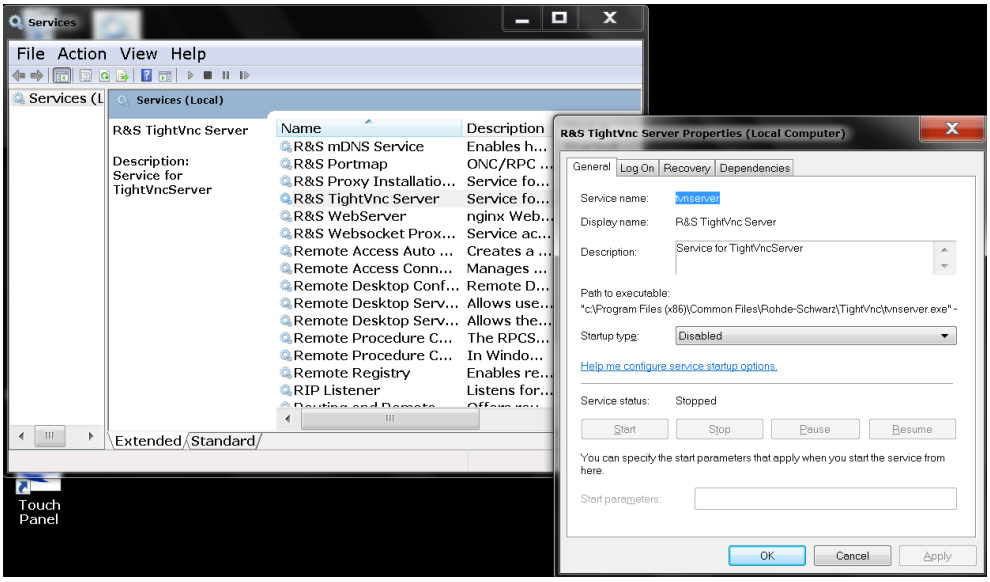
11.4.6 How to Deactivate the Web Browser Interface

If you want to prevent other users in the LAN from accessing or operating the R&S FSWP via its LXI web browser interface, you must deactivate this function. Note that **after a firmware update** the function is **automatically active** again until you deactivate it manually.

To deactivate the LXI web browser interface

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. In the "Start" menu, select "Control Panel".
3. Select "System and Security" > "Administrative Tools".
4. From the list on the right, select "Services".
5. From the list of local services, select "R&S TightVNC Server".



6. Set "Startup type" to "Disabled".
7. Select "Stop".
8. Select "Apply".

   The next time a user enters the IP address of the instrument in a web browser, an error message is displayed:
   `Failed to connect to server (code. 1006)`

11.4.7 How to Set Up Remote Desktop

Remote Desktop is a Windows application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer, and Remote Desktop provides access to all of the applications, files, and network resources of the instrument. Thus, remote operation of the R&S FSWP is possible.

With Microsoft Windows, Remote Desktop Client is part of the operating system. For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on. For details refer to the Microsoft Windows operating system documentation.

This section provides basic instructions on setting up the Remote Desktop for the R&S FSWP.

11.4.7.1 How to Configure the R&S FSWP for Remote Operation via Remote Desktop

1. Create a fixed IP address for the TCP/IP protocol as described in chapter 11.4.1.2, "How to Assign the IP Address", on page 259.

   Note: To avoid problems, use a fixed IP address.

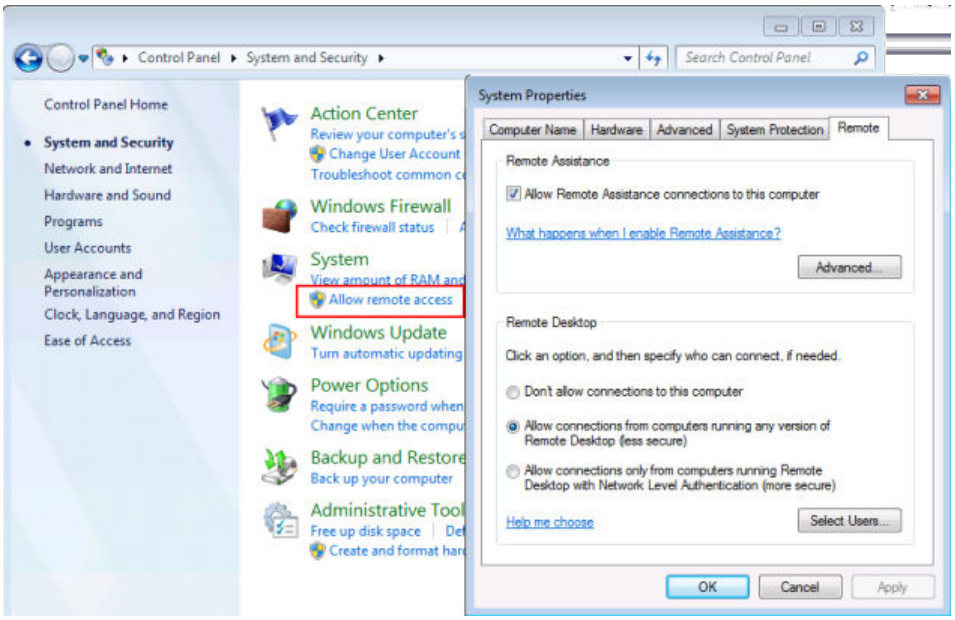
When a DHCP server is used, a new IP address is assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, using a DHCP server is not suitable for remote operation of the R&S FSWP via Remote Desktop.

2.

   Select the "Windows" icon in the toolbar to access the operating system.

3. In the "Start" menu, select the "Control Panel" and then "System and Security".

4. In the "System" area, select "Allow remote access".



5. In the "Remote" tab, in the "Remote Desktop" area, activate the "Allow connections from computers running Remote Desktop" option.

6. Define which users are to be given access to the R&S FSWP via Remote Desktop.
   Note: The user account under which configuration is carried out is automatically enabled for Remote Desktop.

   a) Select the "Select Users" button.
   b) Select the users or create new user accounts as described in chapter 11.4.3.1, "How to Create Users", on page 266.
   c) Select "OK" to confirm the settings.

7. The R&S FSWP is now ready for connection setup with the Remote Desktop program of the controller.

11.4.7.2 How to Add or Remove Users to the Remote Desktop Users Group

Only users in the Remote Desktop Users Group are allowed to connect to the R&S FSWP via Remote Desktop. You can add the users to this group directly when you allow remote access on the R&S FSWP, as described in chapter 11.4.7, "How to

Set Up Remote Desktop", on page 270. Furthermore, you can add or remove users to this group at any time.

1.

   Select the "Windows" icon in the toolbar to access the operating system.

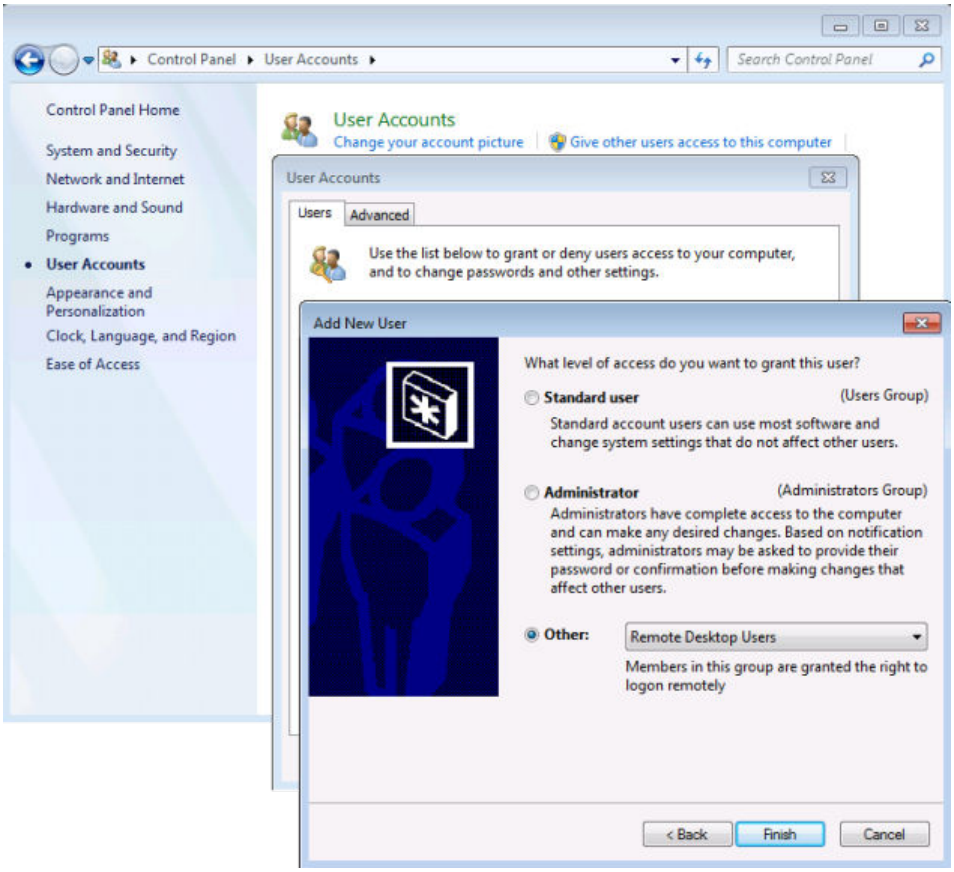
2. In the "Start" menu, select "Control Panel" and then select "User Accounts."

3. Select "Give other users access to this computer".
   The "User Accounts" dialog box is displayed with a list of users and the user group they are assigned to.

4. Give existing users the right to access the R&S FSWP via Remote Desktop:
   a) Select the user from the list and then select the "Properties" button.
   b) As the level of access you want to allow the user, select "Other", then select "Remote Desktop Users" from the dropdown list.
   c) Select the "Finish" button.
   The user is added to the Remote Desktop Users Group.

5. Create new users who may access the R&S FSWP via Remote Desktop:
   a) Select "Add".
   b) Enter the name of the new remote user in the text field and select "Next".

c) As the level of access you want to allow the new user, select "Other", then select "Remote Desktop Users" from the dropdown list.


Control Panel ▸ User Accounts ▸
Search Control Panel
Control Panel Home
System and Security
Network and Internet
Hardware and Sound
Programs
User Accounts
Appearance and Personalization
Clock, Language, and Region
Ease of Access
User Accounts
Change your account picture
Give other users access to this computer
User Accounts
Users
Advanced
Use the list below to grant or deny users access to your computer, and to change passwords and other settings.
Add New User
What level of access do you want to grant this user?
Standard user
(Users Group)
Standard account users can use most software and change system settings that do not affect other users.
Administrator
(Administrators Group)
Administrators have complete access to the computer and can make any desired changes. Based on notification settings, administrators may be asked to provide their password or confirmation before making changes that affect other users.
Other:
Remote Desktop Users
Members in this group are granted the right to logon remotely
< Back
Finish
Cancel

d) Select the "Finish" button.
The user is created.

6. Remove users from the Remote Desktop Users Group:

   a) Select the user from the list and then select the "Remove" button.
   b) Select "OK" to confirm the action.

   Note: Users with administrator rights retain their access rights via Remote Desktop even when they have been removed from the Remote Desktop Users Group.

7. Select "OK" to close the dialog box.

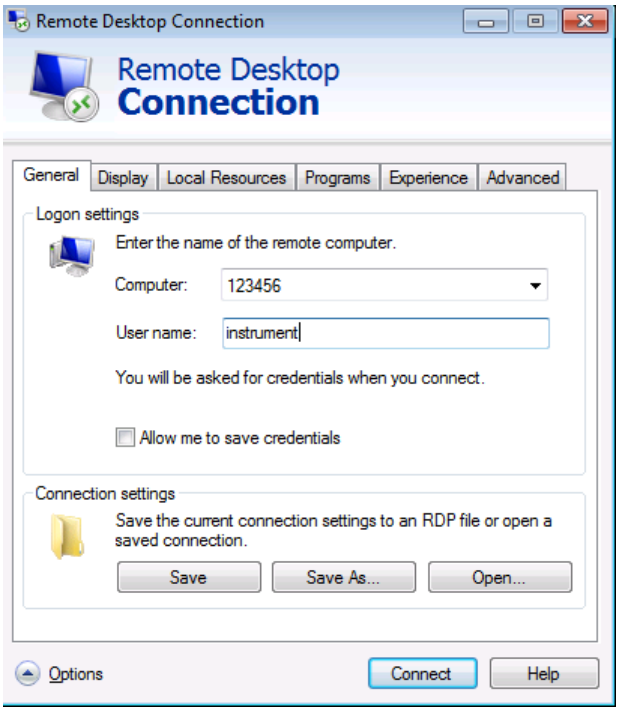
11.4.7.3 How to Configure the Controller

Remote Desktop Client

With Microsoft Windows, Remote Desktop Client is part of the operating system and can be accessed via "Start > Programs > Accessories > Remote Desktop Connection".

For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on.

1. In the "Start" menu of the controller, select "All Programs > Accessories > Remote Desktop Connection".
   The "Remote Desktop Connection" dialog box is displayed.
2. Select the "Options >>" button.
   The dialog box is expanded to display the configuration data.



3. Open the "Experience" tab.
   The settings on this tab are used to select and optimize the connection speed.
4. In the list, select the appropriate connection (for example: LAN (10 Mbps or higher)).
   Depending on your selection (and how powerful the connection is), the options are activated or deactivated.
5. To improve the performance, you can deactivate the "Desktop background", "Show window contents while dragging" and "Menu and window animation" options.
6. Open the "Local Resources" tab to enable printers, local drives and serial interfaces.
7. If you will need to access drives of the controller from the R&S FSWP (e.g. in order to store settings or to copy files from the controller to the R&S FSWP), activate the "Disk drives" option.
   Windows will then map drives of the controller to the corresponding network drives.
8. To use printers connected to the controller while accessing them from the R&S FSWP, activate the "Printers" options. Do not change the remaining settings.
9. Open the "Display" tab.
   The options to configure the R&S FSWP screen display are displayed.

10. Under "Remote desktop size", you can set the size of the R&S FSWP window on the desktop of the controller.
11. Under "Colors", do not change the settings.
12. Set the "Display the connection bar when I use the full screen" option:
    If activated, a bar showing the network address of the R&S FSWP will appear at the top edge of the screen. You can use this bar to reduce, minimize or close the window.
    If deactivated, the only way you can return to the controller desktop from the R&S FSWP screen in full screen mode is to select "Disconnect" from the "Start" menu.

11.4.7.4 How to Start and Close the Remote Desktop

To set up a connection to the R&S FSWP

1. In the "Remote Desktop Connection" dialog box (see chapter 11.4.7.3, "How to Configure the Controller", on page 273), open the "General" tab.
2. In the "Computer" field, enter the IP address of the R&S FSWP.
   In the "User name" field, enter *instrument* to log in as an administrator, or *Normal User* to log in as a standard user.
   In the "Password" field, enter *894129*.
3. To save the connection configuration for later use:
   a) Select the "Save As" button.
      The "Save As" dialog box is displayed.
   b) Enter the name for the connection information (`*.RDP`).
4. To load an existing connection configuration:
   a) Select the "Open" button.
      The "Open" dialog box is displayed.
   b) Select the `*.RDP` file.
5. Select the "Connect" button.
   The connection is set up.
6. If the "Disk drives" option is activated on the "Local Resources" tab, a warning is displayed indicating that the drives are enabled for access from the R&S FSWP. Select "OK" to confirm the warning.
7. After a few moments, the R&S FSWP screen is displayed.
   If a dark screen appears or a dark square appears in the upper left-hand corner of the screen, you must restart the R&S FSWP in order to see the modified screen resolution.

	• Press the key combination ALT + F4. • The R&S FSWP firmware is shut down, which may take a few seconds. • On the desktop, double-tap the "Analyzer" icon.

The firmware restarts and then automatically opens the "Soft Front Panel", i.e. the user interface on which all front panel controls and the rotary knob are mapped to buttons.
For more information see chapter 10.5.7, "How to Work with the Soft Front Panels", on page 210.

8. To deactivate or activate the "Softfrontpanel", press the F6 key.
After the connection is established, the R&S FSWP screen is displayed in the "Remote Desktop" application window.

The Windows "Start" menu can be made available by expanding the "Remote Desktop" window to full size.
During the connection with the controller, the login entry is displayed on the R&S FSWP screen.

To terminate Remote Desktop control

The connection can be terminated by the controller or by a user at the R&S FSWP:

1. On the controller, close the "Remote Desktop" window at any time.
The connection to the R&S FSWP is terminated.
2. On the R&S FSWP, a user logs on.

The connection to the controller is terminated as a result. A message is displayed on the controller display indicating that another user has assumed control of the instrument.

Restoring the connection to the R&S FSWP

Follow the instructions above for setting up a connection to the R&S FSWP. If the connection is terminated and then restored, the R&S FSWP remains in the same state.

11.4.7.5 How to Shut Down the R&S FSWP via Remote Operation

1. Select the R&S FSWP softfrontpanel and close the application with the key combination ALT + F4.
2. Select the desktop and press the key combination ALT + F4.
   A safety query is displayed to warn you that the instrument cannot be reactivated via remote operation and asks you whether you want to continue the shutdown process.
3. Respond to the safety query with "Yes".
   The connection with the controller is terminated and the R&S FSWP is shut down.

11.4.8 How to Start a Remote Control Session from a PC

When you switch on the R&S FSWP, it is always in manual operation state ("local" state) and can be operated via the front panel.

To start remote control

1. Send an addressed command (`GTR` - Go to Remote) from a controller to the instrument.

   The instrument is switched to remote control ("remote" state). Operation via the front panel is disabled. Only the "Local" softkey is displayed to return to manual operation. The instrument remains in the remote state until it is reset to the manual state via the instrument or via remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the other instrument settings.
2. During program execution, send the `SYSTem:DISPlay:UPDate ON` command to activate the display of results (see `SYSTem:DISPlay:UPDate` on page 411).

   The changes in the device settings and the recorded measurement values are displayed on the instrument screen.
3. To obtain optimum performance during remote control, send the `SYSTem:DISPlay:UPDate OFF` command to hide the display of results and diagrams again (default setting in remote control).

4. To prevent unintentional return to manual operation, disable the keys of the instrument using the universal command `LLO`.

   Switching to manual mode is only possible via remote control then. This function is only available for the GPIB interface.

5. To enable the keys of the R&S FSWP again, switch the instrument to local mode (`GTL` - Go to Local), i.e. deactivate the `REN` line of the remote control interface.

If the instrument is operated exclusively in remote control, it is recommended that you switch on the power-save mode for the display. For more details on this mode refer to the "Overview".

11.4.9 How to Return to Manual Operation

Before you switch back to manual operation, all remote command processing must be completed. Otherwise, the instrument will switch back to remote control immediately.

► Select the "Local" softkey or the PRESET key, or use the following GPIB command:

```
status = viGpibControlREN(vi, VI_GPIB_REN_ADDRESS_GTL)
```

If you select the "Local" softkey while a self-alignment or a self-test is still running (which was started remotely), the instrument only returns to the manual operation state when the alignment or test is completed.

12 Remote Control

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12.1 Conventions Used in SCPI Command Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitely.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSWP follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

12.2 Common Suffixes

In the Phase Noise application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<ch>	1..18 (TX channel) 1..11 (ALT channel)	Channel
<i>	1..3	Output (1, 2 or Phones)
<k>	1..8 (Limit line) 1 | 2 (Display line)	Line
<m>	1..16	Marker
<n>	1..16	Window
<t>	1..6	Trace

Selecting windows in a measurement channel

Note that the suffix <n> always refers to the window in the currently selected measurement channel.

12.3 Common Commands

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*PSC....283
*RST....283
*SRE....283
*STB?....283
*TRG....283
*TST?....284
*WAI....284

***CAL?**

Calibration query

Initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

Note: If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed.

Usage: Query only

Manual operation: See "Starting a Self-alignment" on page 185

***CLS**

Clear status

Sets the status byte (STB), the standard event register (ESR) and the `EVENt` part of the `QUEStionable` and the `OPERation` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE** <Value>

Event status enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:
<Value> Range: 0 to 255

***ESR?**

Event status read

Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:
<Contents> Range: 0 to 255

Usage: Query only

***IDN?**

Identification

Returns the instrument identification.

Example: `Rohde&Schwarz,FSWP-26,1322.8003K26/100005,1.00`

Usage: Query only

Manual operation: See "*IDN Format" on page 254

***IST?**

Individual status query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:
<ISTflag> 0 | 1

Usage: Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

***OPT?**

Option identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the data sheet.

Usage: Query only

***PCB** <Address>

Pass control back

Indicates the controller address to which remote control is returned after termination of the triggered action.

Setting parameters:
<Address> Range: 0 to 30

Usage: Setting only

***PRE** <Value>

Parallel poll register enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value> Range: 0 to 255

***PSC** <Action>

Power on status clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:

<Action> 0 | 1

0
The contents of the status registers are preserved.

1
Resets the status registers.

***RST**

Reset

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

The command is equivalent to `SYSTem:PRESet`.

Usage: Setting only

***SRE** <Contents>

Service request enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal. This common command complements the commands of the TRIGger subsystem.

*TRG corresponds to the INITiate:IMMediate command.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). "0" indicates no errors occured.

Note: If you start a self-test remotely, then select the "Local" softkey while the test is still running, the instrument only returns to the manual operation state after the test is completed. In this case, the self-test cannot be aborted.

Usage: Query only

***WAI**

Wait to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and *OPC).

Usage: Event

12.4 Selecting the Operating Mode and Application

12.4.1 Selecting Mode and Applications

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DISPlay:ATAB <State>

This command switches between the MultiView tab and the most recently displayed measurement channel.

Parameters:

<State> ON | OFF

ON
The MultiView tab is displayed.

OFF
The most recently displayed measurement channel is displayed.

*RST: OFF

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e creates a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

Example:
```
INST:SEL 'PhaseNoise'
INST:CRE:DUPL
```
Duplicates the channel named 'PhaseNoise' and creates a new measurement channel named 'PhaseNoise 2'.

Usage: Event

Manual operation: See "Duplicate Current Channel" on page 81

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

This command adds an additional measurement channel.

The number of measurement channels you can configure at the same time depends on available memory.

See also

- `INSTrument[:SELect]` on page 287
- `INSTrument:CREate:DUPLicate` on page 285

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 286.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 286).

Example:
```
INST:CRE PNO, 'PhaseNoise 2'
```
Adds an additional phase noise display named "PhaseNoise 2".

Manual operation: See "New Channel" on page 81

INSTrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a measurement channel with another one.

Setting parameters:

<ChannelName1> String containing the name of the measurement channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 286.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 286).

Example: `INST:CRE:REPL 'PhaseNoise',PNO,'PNO2'`
Replaces the channel named 'PhaseNoise' by a new measurement channel of type 'Phase Noise' named 'PNO2'.

Usage: Setting only

Manual operation: See "Replace Current Channel" on page 81

INSTrument:DELete <ChannelName>

This command deletes a measurement channel.

If you delete the last measurement channel, the default "Phase Noise" channel is activated.

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'PhaseNoise'`
Deletes the channel with the name 'PhaseNoise'.

Usage: Event

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 2 measurement channels:
`'PNO','PhaseNoise','PNO','PhaseNoise2'`

Usage: Query only

Table 12-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise	PNOISE	Phase Noise
Spectrum (R&S FSWP-B1)	SANALYZER	Spectrum
I/Q Analyzer (R&S FSWP-B1)	IQ	IQ Analyzer
Analog Demodulation (R&S FSWP-K7)	ADEM	Analog Demod
Noise Figure Measurements (R&S FSWP-K30)	NOISE	Noise
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:RENAme <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:
<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'PhaseNoise','PNO'`
Renames the channel with the name PhaseNoise' to 'PNO'.

Usage: Setting only

INSTrument[:SELect] <ChannelType> | <ChannelName>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

Also see

- `INSTrument:CREate[:NEW]` on page 285
- chapter 12.4.3, "Programming Example: Performing a Sequence of Measurements", on page 290

Parameters:
<ChannelType> Channel type of the new channel.
For a list of available channel types see `INSTrument:LIST?` on page 286.

<ChannelName> String containing the name of the channel.

Example: `INST IQ`
Activates a measurement channel for the I/Q Analyzer application (evaluation mode).
`INST 'MyIQSpectrum'`
Selects the measurement channel named 'MyIQSpectrum' (for example before executing further commands for that channel).

Usage: SCPI confirmed

Manual operation: See "Phase Noise" on page 79
See "Spectrum" on page 79
See "Analog Demodulation" on page 79
See "I/Q Analyzer" on page 80
See "Noise Figure" on page 80
See "Vector Signal Analysis (VSA)" on page 80
See "New Channel" on page 81

12.4.2 Performing a Sequence of Measurements

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INITiate<n>:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate<n>:SEQuencer:IMMediate` on page 288.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 290.

Suffix:
<n> irrelevant

Usage: Event

Manual operation: See "Sequencer State" on page 84

INITiate<n>:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Its effect is similar to the `INITiate<n>[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 290).

Suffix:
<n> irrelevant

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Usage: Event

Manual operation: See "Sequencer State" on page 84

INITiate<n>:SEQuencer:MODE <Mode>

This command selects the way the R&S FSWP application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 290).

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

Suffix:
<n> irrelevant

Parameters:
<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Manual operation: See "Sequencer Mode" on page 84

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single Sequencer mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

Manual operation: See "Sequencer State" on page 84

12.4.3 Programming Example: Performing a Sequence of Measurements

This example demonstrates how to perform several measurements in a sequence in a remote environment.

Note that it is based on the optional Spectrum application. Doing this for the Phase Noise application, however, works the same way.

```
//2xSpectrumanalyzer + 2xIQ, start Sequencer at the end, test OPC?
// ----------------------------------------------------------------------


//------Preparing the instrument and first channel -----------
*RST
//Activate new IQ channel
INSTrument:CREate:NEW IQ,'IQ 1'
//Set sweep count for new IQ channel
SENS:SWEEP:COUNT 6
//Change trace modes for IQ channel
DISP:TRAC1:MODE BLANK
DISP:TRAC2:MODE MAXH
```

```
DISP:TRAC3:MODE MINH
//Switch to single sweep mode
INIT:CONT OFF
//switch back to first (default) analyzer channel
INST:SEL 'Spectrum';*WAI
//Switch into SEM
SENSe:SWEep:MODE ESPectrum
//Load Sem standard file for W-CDMA
SENSe:ESPectrum:PRESet:STANdard 'WCDMA\3GPP\DL\3GPP_DL.xml'
//Set sweep count in Spectrum channel
SENS:SWEEP:COUNT 5

//----------Creating a second measurement channel ----------------

//Create second IQ channel
INSTrument:CREate:NEW IQ,'IQ 2'
//Set sweep count
SENS:SWEEP:COUNT 2
//Change trace modes
DISP:TRAC1:MODE MAXH
DISP:TRAC2:MODE MINH
//Create new analyzer channel
INSTrument:CREate:NEW SANalyzer,'Spectrum 2'
//Activate ACLR measurement in channel 'Spectrum 2'
CALCulate:MARKer:FUNCtion:POWer:SELect ACPower
//Load W-CDMA Standard
CALCulate:MARKer:FUNCtion:POWer:PRESet FW3Gppcdma
//Change trace modes
DISP:TRAC2:MODE MAXH
DISP:TRAC1:MODE MINH

//--------Performing a sweep and retrieving results----------------

//Change sweep count
SENS:SWEep:COUNt 7
//Single Sweep mode
INIT:CONT OFF
//Switch back to first IQ channel
INST:SEL 'IQ 1';*WAI
//Perform a measurement
INIT:IMM;*OPC?
//Retrieve results
CALC:MARK:Y?
//Activate Multiview
DISPlay:ATAB     ON

//---------Performing a sequence of measurements with the Sequencer------------
//Activate Sequencer
SYSTem:SEQuencer ON
//Start sweep in Sequencer
```

```
INITiate:SEQuencer:IMMediate;*OPC?
//Switch into first IQ channel to get results
INST:SEL 'IQ 1';*WAI
CALCulate:MARKer:MAXimum
CALC:MARK:Y?
//Change sweep time in IQ
SENS:SWE:TIME 300us
//Switch to single Sequencer mode
INITiate:SEQuencer:MODE SINGle
//Sweep all channels once, taking the sweep count in each channel into account
INITiate:SEQuencer:IMMediate;*OPC?
//Set marker to maximum in IQ1 and query result
CALCulate:MARKer:MAXimum
CALC:MARK:Y?
//Switch to second IQ channel and retrieve results
INST:SEL 'IQ 2';*WAI
CALCulate:MARKer:MIN
CALC:MARK:Y?
//Switch to first Spectrum channel
INST:SEL 'Spectrum';*WAI
//Query one of the SEM results
CALCulate:MARKer:FUNCtion:POWer:RESult? CPOWer
//Switch to second Spectrum channel
INST:SEL 'Spectrum 2';*WAI
//Query channel power result
CALCulate:MARKer:FUNCtion:POWer:RESult? ACPower
```

12.5 Measurements and Result Displays

Commands to query results described elsewhere:

- `CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:X?` on page 326
- `CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:Y?` on page 326
- `CALCulate<n>:SNOise<m>[:TRACe<t>]:Y?` on page 328

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FETCh<n>[:RANGe<r>]:PNOise<t>:RFM? 296
FETCh<n>[:RANGe<r>]:PNOise<t>:RMS? 296
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INITiate<n>:CONMeas 297

INITiate<n>:CONTinuous....298
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TRACe<n>[:DATA]?....299

ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

To abort a sequence of measurements by the Sequencer, use the `INITiate<n>:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSWP is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSWP on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example:
```
ABOR;*WAI
INIT:IMM
```
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event
SCPI confirmed

CONFigure:PNOise:MEASurement <Measurement>

This command selects the measurement.

Parameters:

<Measurement>

PNOise
Select the Phase Noise measurement.

PPNoise
Selects the Pulsed Phase Noise measurement.

RESidual
Selects the Additive Noise measurement.

*RST: PNOise

Example:
```
CONF:PNO:MEAS RES
```
Selects the Additive Noise measurement.

Manual operation:
See "Phase Noise Measurement" on page 90
See "Additive Noise measurements (optional)" on page 90
See "Pulsed Phase Noise measurements (optional)" on page 90
See "Selecting the noise measurement type" on page 96

FETCh<n>:PNOise<t>:SPURs?

This command queries the location and level of all spurs that have been detected.

Suffix:

<n> 1..n

<t> 1..n

Return values:

<SpurCoordinates> Returns two values (frequency and level) for each each spur that has been detected.

Example:
```
FETC:PNO:SPUR?
```
would return, e.g.
```
1999.232666,-0.639974,6494.312500,-0.760579,
19992.324219,-0.639974
```

Usage: Query only

Manual operation:
See "Spurious List" on page 92

FETCh<n>:PNOise<t>:SPURs:DISCrete?

This command queries the Discrete Jitter result.

Suffix:

<n> 1..n

<t> 1..n

Return values:

<Jitter> <numeric value>

Default unit: s

Example: FETC:PNO:SPUR:DISC?
would return, e.g.
2.3e-08

Usage: Query only

Manual operation: See "Spurious List" on page 92

FETCh<n>:PNOise<t>:SPURs:JITTer?

This command queries the jitter of the measured spurs.

Suffix:
<n> 1..n

<t> 1..n

Return values:
<Jitter> <numeric value>
Default unit: s

Example: FETC:PNO:SPUR:JITT?
would return, e.g.
+2.199886328E+004,+2.440125142E-012,
+7.332938281E+004,[...]

Usage: Query only

Manual operation: See "Spurious List" on page 92

FETCh<n>:PNOise<t>:SPURs:RANDom?

This command queries the Random Jitter result.

Suffix:
<n> 1..n

<t> 1..n

Return values:
<arg0> <numeric value>
Default unit: s

Example: FETC:PNO:SPUR:RAND?
would return, e.g.
3.59e-09

Usage: Query only

Manual operation: See "Spurious List" on page 92

FETCh<n>[:RANGe<r>]:PNOise<t>:IPN?

This command queries the Integrated Phase Noise.

Suffix:

<n> 1..n

<r> 1..n
Selects the integration range.

<t> 1..n

Return values:

<Level> <numeric value>
Default unit: dBc

Example: `FETC:RANG2:PNO2:IPN?`
would return, e.g.
`-16.79`

Usage: Query only

Manual operation: See "Integrated Measurements" on page 91

FETCh<n>[:RANGe<r>]:PNOise<t>:RFM?

This command queries the residual FM.

Suffix:

<n> 1..n

<r> 1..n
Selects the integration range.

<t> 1..n

Return values:

<Frequency> <numeric value>
Default unit: Hz

Example: `FETC:RANG2:PNO:RFM?`
would return, e.g.
`88110000`

Usage: Query only

Manual operation: See "Integrated Measurements" on page 91

FETCh<n>[:RANGe<r>]:PNOise<t>:RMS?

This command queries the residual RMS jitter.

Suffix:

<n> 1..n

<r> 1..n
Selects the integration range.

<t> 1..n

Return values:

<Jitter> <numeric value>
Default unit: s

Example: `FETC:RANG2:PNO2:RMS?`
would return, e.g.
`0.02175`

Usage: Query only

Manual operation: See "Integrated Measurements" on page 91

FETCh<n>[:RANGe<r>]:PNOise<t>:RPM?

This command queries the residual PM.

Suffix:

<n> 1..n

<r> 1..n
Selects the integration range.

<t> 1..n

Return values:

<Phase> <numeric value>
Default unit: deg

Example: `FETC:RANG2:PNO:RPM?`
would return, e.g.
`11.73`

Usage: Query only

Manual operation: See "Integrated Measurements" on page 91

INITiate<n>:CONMeas

This command restarts a (single) measurement that has been stopped (using `ABORt`) or finished in single measurement mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate<n>[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Suffix:

<n> irrelevant

Usage: Event

Manual operation: See "Continue Single Sweep" on page 89

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual measurement channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see chapter 11.1.6, "Command Sequence and Synchronization", on page 228.

If the measurement mode is changed for a measurement channel while the Sequencer is active the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

Manual operation: See "Continuous Sweep/RUN CONT" on page 89

INITiate<n>[:IMMediate]

This command starts a (single) new measurement.

With measurement count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see chapter 11.1.6, "Command Sequence and Synchronization", on page 228.

Suffix:
<n> irrelevant

Usage: Event

Manual operation: See "Single Sweep/ RUN SINGLE" on page 88

TRACe<n>[:DATA]? <Trace>

This command queries the trace data (measurement results).

Suffix:
<n> 1..n

Query parameters:
<Trace> **TRACE1 | ... | TRACE6**
Queries the data of one of the colored line traces.

XGINdicator
Queries the data of the cross-correlation gain indicator (grey area).

Return values:
<Result> Coordinates of the trace as list of comma separated values, beginning at the nearest offset frequency.

Example: `TRAC? TRACE1`
would return the data of trace 1, e.g.:
`1000.000000,-82.326393,1011.579712,-82.411499,`
`1023.292969,-82.538643,[...]`

Usage: Query only

Manual operation: See "Noise Diagram" on page 91

12.6 Common Measurement Settings

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- Output 300
- Remote Commands to Configure Level Characteristics 311
- Remote Commands to Configure the Frequency 315
- Phase Noise Measurement Configuration 317
- Pulsed Phase Noise Configuration 329

12.6.1 Remote Commands to Configure the Input Source

- RF Input 299

12.6.1.1 RF Input

INPut:COUPling 299
INPut:SELect 300

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType>

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 98

INPut:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSWP.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

*RST: RF

Manual operation: See "Radio Frequency State" on page 98

12.6.2 Output

- DC Power....300
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12.6.2.1 DC Power

SOURce:CURRent:AUX:LIMit:HIGH?....301
SOURce:CURRent:CONTrol<i>:LIMit:HIGH?....301
SOURce:CURRent:POWer<i>:LIMit:HIGH....301
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SOURce:POWer:SEQuence:RESult?....302
SOURce:VOLTage:AUX:LEVel:AMPLitude....303
SOURce:VOLTage:AUX:LEVel:LIMit:HIGH....303
SOURce:VOLTage:AUX:LEVel:LIMit:LOW....303
SOURce:VOLTage:AUX:LEVel[:STATe]....303
SOURce:VOLTage:CHANnel:COUPling....304
SOURce:VOLTage:CONTrol<i>:LEVel:AMPLitude....304
SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:HIGH....304
SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:LOW....305
SOURce:VOLTage:CONTrol<i>:LEVel[:STATe]....305
SOURce:VOLTage:POWer<i>:LEVel:AMPLitude....306
SOURce:VOLTage:POWer<i>:LEVel:LIMit:HIGH....306
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SOURce:VOLTage:POWer<i>:LEVel:MODE....307
SOURce:VOLTage:POWer<i>:LEVel[:STATe]....307
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SOURce:VOLTage:SEQuence:RESult?....308
SOURce:VOLTage[:STATe]....309

SOURce:CURRent:AUX:LIMit:HIGH?

This command returns the maximum current of the V_{aux} connector.

Return values:

<Current> <numeric value>
The return value is always 0.1 A.

Example: `SOUR:CURR:AUX:LIM:HIGH?`
returns
`0.1`

Usage: Query only

SOURce:CURRent:CONTrol<i>:LIMit:HIGH?

This command returns the maximum current of the V_{tune} connector.

Suffix:

<i> 1..n
irrelevant

Return values:

<Current> <numeric value>
The return value is always 0.02 A.
Default unit: A

Example: `SOUR:CURR:CONT:LIM:HIGH?`
returns
`0.02`

Usage: Query only

SOURce:CURRent:POWer<i>:LIMit:HIGH <Current>

This command defines the maximum current of the V_{supply} connector.

The command is available when the output is controlled in terms of voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).

Suffix:

<i> 1..n
irrelevant

Parameters:

<Current> <numeric value>

Range: 0 to 2
*RST: 2
Default unit: A

Example: `SOUR:CURR:POW:LIM:HIGH 1`
Defines a maximum output current of 1000 mA.

SOURce:CURRent:SEQuence:RESult?

This command queries the actually measured current on the DC power sources.

The command is available when the DC power sources have been turned on with `SOURce:VOLTage[:STATe]`.

Return values:

<Current> Three values as a comma separated list.
- The first value represents the current of V_{supply}.
- The second value represents the current of V_{tune}.
- The third value represents the current of V_{aux}.

Default unit: V

Example: `SOUR:CURR:SEQ:RES?`
would return, e.g.
`0.000000, -0.100000, -0.020000`

Usage: Query only

Manual operation: See "Reading the actual output levels" on page 114

SOURce:POWer:SEQuence:RESult?

This command queries the actually measured power (U*I) on the DC power sources.

The command is available when the DC power sources have been turned on with `SOURce:VOLTage[:STATe]`.

Return values:

<Power> Three values as a comma separated list.
- The first value represents the power of V_{supply}.
- The second value represents the power of V_{tune}.
- The third value represents the power of V_{aux}.

Default unit: V

Example: `SOUR:POW:SEQ:RES?`
would return, e.g.
`0.000000, 1.000000, 0.200000`

Usage: Query only

Manual operation: See "Reading the actual output levels" on page 114

SOURce:VOLTage:AUX:LEVel:AMPLitude <Voltage>

This command defines the output voltage for the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: `SOUR:VOLT:AUX:LEV:AMPL 1`
Defines an output voltage of 1 V on the V_{aux} source.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:AUX:LEVel:LIMit:HIGH <Voltage>

This command defines the maximum voltage that may be supplied by the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: `SOUR:VOLT:AUX:LEV:LIM:HIGH 5`
Defines a maximum voltage of 5 V.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:AUX:LEVel:LIMit:LOW <Voltage>

This command defines the minimum voltage that may be supplied by the V_{aux} source.

Parameters:

<Voltage> <numeric value>

Range: -10 to 10
*RST: 0
Default unit: V

Example: `SOUR:VOLT:AUX:LEV:LIM:LOW -5`
Defines a minimum voltage of -5 V.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:AUX:LEVel[:STATe] <State>

This command turns the auxilliary voltage source (V_{aux}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general with `SOURce:VOLTage[:STATe]`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: SOUR:VOLT:AUX:LEV ON
Turns on the V_{aux} source.

Manual operation: See "Turning the output on and off" on page 113

SOURce:VOLTage:CHANnel:COUPling <State>

This command couples or decouples the DC power configuration across measurement channels.

Parameters:

<State>

ON
DC power configuration is the same across all measurement channels.

OFF
DC power configuration is different for each measurement channel.

*RST: ON

Example: SOUR:VOLT:CHAN:COUP OFF
Allows you to define a different DC power setup for each active measurement channel.

Manual operation: See "Coupling the output configuration across measurement channels" on page 112

SOURce:VOLTage:CONTrol<i>:LEVel:AMPLitude <Voltage>

This command defines the output voltage for the V_{tune} source.

Suffix:

<i> 1..n
irrelevant

Parameters:

<Voltage> <numeric value>

Range: -10 to 28
*RST: 0
Default unit: V

Example: SOUR:VOLT:AUX:LEV:AMPL 1
Defines an output voltage of 1 V on the V_{tune} source.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:HIGH <Voltage>

This command defines the maximum voltage that may be supplied by the V_{tune} source.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage> <numeric value>
Range: -10 to 28
*RST: 0
Default unit: V

Example: `SOUR:VOLT:CONT:LEV:LIM:HIGH 5`
Defines a maximum voltage of 5 V.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:CONTrol<i>:LEVel:LIMit:LOW <Voltage>

This command defines the minimum voltage that may be supplied by the V_{tune} source.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage> <numeric value>
Range: -10 to 28
*RST: 0
Default unit: V

Example: `SOUR:VOLT:CONT:LEV:LIM:LOW -5`
Defines a minimum voltage of -5 V.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:CONTrol<i>:LEVel[:STATe] <State>

This command turns the tuning voltage source (V_{tune}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general with `SOURce:VOLTage[:STATe]`.

Suffix:
<i> 1..n
irrelevant

Parameters:
<State> ON | OFF
*RST: OFF

Example: `SOUR:VOLT:CONT:LEV ON`
Turns on the V_{tune} voltage source.

Manual operation: See "Turning the output on and off" on page 113

SOURce:VOLTage:POWer<i>:LEVel:AMPLitude <Voltage/Current>

This command defines the output voltage for the V_{supply} source.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).
When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 0 V or 2000 mA
Default unit: V or A

Example: `SOUR:VOLT:AUX:LEV:AMPL 1`
Defines an output voltage of 1 V on the V_{supply} source.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:POWer<i>:LEVel:LIMit:HIGH <Voltage/Current>

This command defines the maximum voltage that may be supplied by the V_{supply} source.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).
When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example: `SOUR:VOLT:POW:LEV:LIM:HIGH 1000MA`
Defines a maximum current of 1000 mA.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:POWer<i>:LEVel:LIMit:LOW <Voltage/Current>

This command defines the minimum voltage that may be supplied by the V_{supply} source.

select whether you want to control the output in terms of current or voltage.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Voltage/Current> <numeric value>

The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).
When you control it in terms of voltage, the value is a voltage (V). When you control it in terms of current, the value is the current (A).

Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example: `SOUR:VOLT:POW:LEV:LIM:LOW 500MA`
Defines a minimum current of 500 mA.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:POWer<i>:LEVel:MODE <Mode>

This command select whether you want to control the output in terms of current or voltage.

Suffix:
<i> 1..n
irrelevant

Parameters:
<Mode> **CURRent**
Control the output in terms of current.

VOLTage
Controls the output in terms of voltage.

*RST: VOLTage

Example: `SOUR:VOLT:POW:LEV:MODE VOLT`
Controls the V_{supply} source in terms of voltages.

Manual operation: See "Selecting the output type (Vsupply only)" on page 113

SOURce:VOLTage:POWer<i>:LEVel[:STATe] <State>

This command turns the supply voltage source (V_{supply}) on and off.

Note that DC power is actually supplied only if you additionally activate the outputs in general with `SOURce:VOLTage[:STATe]`.

Suffix:
<i> 1..n
irrelevant

Parameters:
<State> ON | OFF
*RST: ON

Example: `SOUR:VOLT:POW:LEV ON`
Turns on the V_{supply} voltage source.

Manual operation: See "Turning the output on and off" on page 113

SOURce:VOLTage:POWer<i>:LIMit:HIGH <Voltage>

This command defines the maximum current or voltage that may be supplied by the V_{supply} source.

Suffix:
<i> 1..n
inrrelevant

Parameters:
<Voltage> <numeric value>
The type of value depends on whether you control the output in terms of current or voltage (`SOURce:VOLTage:POWer<i>:LEVel:MODE`).
When you control it in terms of voltage, the value is a current (A). When you control it in terms of current, the value is a voltage (V).
Range: 0 to 16 V or 2000 mA
*RST: 16 V or 2000 mA
Default unit: V or A

Example:
```
SOUR:VOLT:POW:LEV:MODE VOLT
SOUR:VOLT:POW:LIM:HIGH 1000MA
```
Defines a maximum output of 1000 mA.

Manual operation: See "Defining the output level" on page 113

SOURce:VOLTage:SEQuence:RESult?

This command queries the actually measured voltages on the DC power sources.

The command is available when the DC power sources have been turned on with `SOURce:VOLTage[:STATe]`.

Return values:

<Voltage> Three values as a comma separated list.
- The first value represents the voltage of V_{supply}.
- The second value represents the voltage of V_{tune}.
- The third value represents the voltage of V_{aux}.

Default unit: V

Example: `SOUR:VOLT:SEQ:RES?`
would return, e.g.
`0.000000, -10.000000, -10.000000`

Usage: Query only

Manual operation: See "Reading the actual output levels" on page 114

SOURce:VOLTage[:STATe] <State>

This command turns DC power sources on and off in general.

When you turn the DC power sources off, no power is supplied even when you have turned on one of the sources individually with one of the following commands.

- `SOURce:VOLTage:AUX:LEVel[:STATe]`
- `SOURce:VOLTage:CONTrol<i>:LEVel[:STATe]`
- `SOURce:VOLTage:POWer<i>:LEVel[:STATe]`

Parameters:

<State> **ON**
DC power sources are ready for use.

OFF
DC power sources are turned off.

*RST: OFF

Example: `SOUR:VOLT ON`
Turns on the outputs.

Manual operation: See "Turning the DC output on and off" on page 112

12.6.2.2 Signal Source

SOURce:GENerator:DUTBypass....309
SOURce:GENerator:CHANnel:COUPling....310
SOURce:GENerator:FREQuency....310
SOURce:GENerator:LEVel....310
SOURce:GENerator[:STATe]....311

SOURce:GENerator:DUTBypass <State>

This command turns the DUT bypass on and off.

When you turn on the bypass, the application measures the noise characteristics of the R&S FSWP.

The DUT bypass is available with the optional SIgnal Source hardware component.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SOUR:GEN:DUTB ON`
Measures the intrinsic noise of the R&S FSWP.

Manual operation: See "Bypassing the DUT" on page 115

SOURce:GENerator:CHANnel:COUPling <State>

This command couples or decouples the signal source configuration across measurement channels.

Parameters:

<State> **ON**
Signal source configuration is the same across all measurement channels.

OFF
Signal source configuration is different for each measurement channel.

*RST: ON

Example: `SOUR:GEN:CHAN:COUP OFF`
Allows you to define a different signal source setup for each active measurement channel.

Manual operation: See "Coupling the output configuration across measurement channels" on page 112

SOURce:GENerator:FREQuency <Frequency>

This command defines the frequency of the signal that is generated by the signal source.

Parameters:

<Frequency> <numeric value>

Default unit: Hz

Example: See `SOURce:GENerator[:STATe]` on page 311.

Manual operation: See "Defining the signal characteristics" on page 115

SOURce:GENerator:LEVel <Level>

This command defines the level of the signal that is generated by the signal source.

Parameters:

<Level> <numeric value>

Default unit: dBm

Example: See SOURce:GENerator[:STATe] on page 311.

Manual operation: See "Defining the signal characteristics" on page 115

SOURce:GENerator[:STATe] <State>

This command turns the optional signal source output on and off.

When you turn on the signal source, the R&S FSWP generates a signal with the frequency and level defined with SOURce:GENerator:FREQuency and SOURce:GENerator:LEVel.

Parameters:

<State> ON | OFF

*RST: OFF

Example:
```
SOUR:GEN:FREQ 100MHZ
SOUR:GEN:LEV -10
SOUR:GEN ON
```
Turns on the signal source output and generates a signal at 100 MHz and a level of -10 dBm.

Manual operation: See "Turning the signal source output on and off" on page 115

12.6.2.3 Miscellaneous Output

DIAGnostic:SERVice:NSOurce....311

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the R&S FSWP on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example:
```
DIAG:SERV:NSO ON
```

Manual operation: See "Noise Source" on page 116

12.6.3 Remote Commands to Configure Level Characteristics

Functions to configure level characteristics described elsewhere:

- INPut:COUPling on page 299

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]....312
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO....312
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel....313
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:LOWer....313
INPut:ATTenuation....313

INPut:ATTenuation:AUTO....314
[SENSe:]ADJust:CONFigure:LEVel:THReshold....314
[SENSe:]POWer:RLEVel?....314
[SENSe:]POWer:RLEVel:OFFSet....315

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe] <Range>

This command defines the value range displayed on the y-axis.

The command is available when you have turned off automatic y-axis scaling with `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO`.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Range> <numeric value>

Default unit: dB

Example:
```
DISP:TRAC:Y:AUTO OFF
DISP:TRAC:Y 100
```
Defines a value range of 100 dB.

Manual operation: See "Scaling the y-axis" on page 101

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO <Mode>

This command turns automatic scaling of the y-axis in graphical result displays on and off.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Mode>

ON
Scales the y-axis after each measurement.

OFF
Allows you to select the scale manually. You can define the scale with the following commands:
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]`
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel`
- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:LOWer`

ONCE
Scales the y-axis once. The scale remains the same for subsequent measurements.

*RST: ON

Example: DISP:TRAC:Y:AUTO OFF
Selects manual scaling of the y-axis.

Manual operation: See "Scaling the y-axis" on page 101

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <Level>

This command defines the maximum level displayed on the y-axis.

The command is available when you have turned off automatic y-axis scaling with DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Level> <numeric value>
Default unit: dBc/Hz

Example: DISP:TRAC:Y:RLEV -20
Maximum level on the y-axis is -20 dBm/Hz.

Manual operation: See "Scaling the y-axis" on page 101

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:LOWer <Level>

This command defines the minimum level displayed on the y-axis.

The command is available when you have turned off automatic y-axis scaling with DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:AUTO.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Level> <numeric value>
Default unit: dBc/Hz

Example: DISP:TRAC:Y:RLEV:LOW?
would return, e.g.
-135

Manual operation: See "Scaling the y-axis" on page 101

INPut:ATTenuation <Attenuation>

This command defines the RF attenuation for the RF input.

The command is available when you turn off automatic determination of the attenuation with INPut:ATTenuation:AUTO.

Parameters:

<Attenuation> <numeric value> (integer only)

Range: See datasheet
Increment: 5
Default unit: dB

Example:
```
INP:ATT:AUTO OFF
INP:ATT 10
```
Defines an attenuation of 10 dB.

Manual operation: See "Attenuating the signal" on page 99

INPut:ATTenuation:AUTO <State>

This command turns automatic determination of the attenuation on and off.

Parameters:

<State>

ON
Automatically defines the ideal attenuation based on the current signal level.

OFF
Allows you to define the attenuation manually with `INPut:ATTenuation`

*RST: ON

Example:
```
INP:ATT:AUTO ON
```
Turns on automatic determination of the attenuation.

Manual operation: See "Attenuating the signal" on page 99

[SENSe:]ADJust:CONFigure:LEVel:THReshold <Level>

This command defines the threshold of the signal search.

The command is available when you turn on the automatic signal search with `[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe]`.

Parameters:

<Level> <numeric value>

Default unit: dBm

Example:
```
ADJ:CONF:LEV:THR -10
```
Defines a threshold of -10 dBm.

Manual operation: See "Searching for the signal level" on page 100

[SENSe:]POWer:RLEVel?

This command queries the currently measured signal level.

Return values:
<Level> <numeric value>
Default unit: dBm

Example: `POW:RLEV?`
would return, e.g.
`-9.28192`

Usage: Query only

Manual operation: See "Searching for the signal level" on page 100

[SENSe:]POWer:RLEVel:OFFSet <Offset>

This command defines an arithmetic level offset. The offset is applied to the signal level.

The level offset takes external attenuation or gain into account.

Parameters:
<Offset> <numeric value>
Range: -100 to 200
*RST: 0
Default unit: dB

Example: `POW:RLEV:OFFS 20`
Defines a level offset of 20 dB.

Manual operation: See "Shifting the level" on page 100

12.6.4 Remote Commands to Configure the Frequency

[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe] 315
[SENSe:]ADJust:CONFigure:FREQuency:LIMit:HIGH 316
[SENSe:]ADJust:CONFigure:FREQuency:LIMit:LOW 316
[SENSe:]FREQuency:CENTer 316
[SENSe:]FREQuency:STARt 317
[SENSe:]FREQuency:STOP 317

[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe] <State>

This command turns the automatic (carrier) frequency search on and off.

When you turn of the automatic frequency search, you can define the signal frequency with `[SENSe:]FREQuency:CENTer`.

Parameters:
<State> ON | OFF

Example:
```
ADJ:CONF:FREQ:AUT OFF
FREQ:CENT 100MHZ
```
Defines a signal frequency of 100 MHz.

Manual operation: See "Searching for a signal" on page 102

[SENSe:]ADJust:CONFigure:FREQuency:LIMit:HIGH <Frequency>

This command defines the upper limit of the frequency search range.

The command is available when you turn on the automatic signal search with `[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe]`.

Parameters:

<Frequency> <numeric value>

Range: See datasheet
*RST: 8 GHz
Default unit: Hz

Example:
```
ADJ:CONF:FREQ:LIM:LOW 10MHZ
ADJ:CONF:FREQ:LIM:UPP 500MHZ
```
Defines a frequency search range from 10 MHz to 500 MHz.

Manual operation: See "Searching for a signal" on page 102

[SENSe:]ADJust:CONFigure:FREQuency:LIMit:LOW <Frequency>

This command defines the lower limit of the frequency search range.

The command is available when you turn on the automatic signal search with `[SENSe:]ADJust:CONFigure:FREQuency:AUTosearch[:STATe]`.

Parameters:

<Frequency> <numeric value>

Range: See datasheet
*RST: 1 MHz
Default unit: Hz

Example:
```
ADJ:CONF:FREQ:LIM:LOW 10MHZ
ADJ:CONF:FREQ:LIM:UPP 500MHZ
```
Defines a frequency search range from 10 MHz to 500 MHz.

Manual operation: See "Searching for a signal" on page 102

[SENSe:]FREQuency:CENTer <Frequency>

This command defines or queries (in case of automatic frequency search) the current signal frequency.

Parameters:

<Frequency> <numeric value>

Default unit: Hz

Example:
```
FREQ:CENT?
```
would return, e.g.
```
101137933
```

Manual operation: See "Defining the signal frequency" on page 102
See "Searching for a signal" on page 102

[SENSe:]FREQuency:STARt <Frequency>

This command defines the start frequency offset of the measurement range.

Parameters:
<Frequency> Offset frequencies in half decade steps.

Range: See datasheet
*RST: 1 kHz
Default unit: Hz

Example: `FREQ:STAR 10KHZ`
Defines a start offset of 10 kHz.

Manual operation: See "Definining the measurement range" on page 103

[SENSe:]FREQuency:STOP <Frequency>

This command defines the stop frequency offset of the measurement range.

Parameters:
<Frequency> Offset frequencies in half decade steps.

Range: See datasheet
*RST: 1 MHz
Default unit: Hz

Example: `FREQ:STOP 10MHZ`
Defines a stop offset of 10 MHz.

Manual operation: See "Definining the measurement range" on page 103

12.6.5 Phase Noise Measurement Configuration

- Measurement Range Configuration 317
- Residual Calculation Configuration 321
- Spot Noise Configuration 325

12.6.5.1 Measurement Range Configuration

Remote commands to configure the measurement range described elsewhere:

- `[SENSe:]FREQuency:STARt` on page 317
- `[SENSe:]FREQuency:STOP` on page 317

DISPlay:XGINdicator[:STATe] 318
[SENSe:]LIST:BWIDth[:RESolution]:RATio 318
[SENSe:]LIST:RANGe<r>:BWIDth[:RESolution]? 318
[SENSe:]LIST:RANGe<r>:FREQuency:STARt? 319
[SENSe:]LIST:RANGe<r>:FREQuency:STOP? 319

[SENSe:]LIST:RANGe<r>:XCOunt?....319
[SENSe:]SWEep:COUNt....320
[SENSe:]SWEep:TIME?....320
[SENSe:]SWEep:XFACtor....321
[SENSe:]SWEep:XOPTimize....321

DISPlay:XGINdicator[:STATe] <State>

This command turns the cross-correlation gain indicator (grey area in the Noise Spectrum result display) on and off.

Parameters:

<State> ON | OFF

*RST: ON

Example: `DISP:XGIN OFF`
Removes the grey area from the diagram area.

Manual operation: See "Turning the display of the cross-correlation gain indicator on and off" on page 106

[SENSe:]LIST:BWIDth[:RESolution]:RATio <Percentage>

This command defines the factor that the resolution bandwidth applied to each half decade is based on.

More information

Parameters:

<Percentage> <numeric value>

Range: 0.1 to 30
*RST: 10
Default unit: PCT

Example: `LIST:BWID:RAT 5`
Defines a RBW factor of 5 %.

Manual operation: See "Defining the resolution bandwidth" on page 105

[SENSe:]LIST:RANGe<r>:BWIDth[:RESolution]?

This command queries the resolution bandwidth applied in a half decade.

Suffix:

<r> 1..n

Return values:

<BandWidth> <numeric value>

Default unit: Hz

Example: `LIST:RANG5:BWID?`
would return, e.g.
`10000`

Usage: Query only

Manual operation: See "Working with the half decade configuration table" on page 107

[SENSe:]LIST:RANGe<r>:FREQuency:STARt?

This command queries the start frequency offset of a half decade.

Suffix:
<r> 1..n

Return values:
<Frequency> <numeric value>
Default unit: Hz

Example: `LIST:RANG5:FREQ:STAR?`
would return, e.g.
`100000`

Usage: Query only

Manual operation: See "Working with the half decade configuration table" on page 107

[SENSe:]LIST:RANGe<r>:FREQuency:STOP?

This command queries the stop frequency offset of a half decade.

Suffix:
<r> 1..n

Return values:
<Frequency> <numeric value>
Default unit: Hz

Example: `LIST:RANG5:FREQ:STOP?`
would return, e.g.
`300000`

Usage: Query only

Manual operation: See "Working with the half decade configuration table" on page 107

[SENSe:]LIST:RANGe<r>:XCOunt?

This command queries the number of cross-correlation operations done in a half decade.

Suffix:
<r> 1..n

Return values:

<Count> <numeric value> (integer only)

Example: `LIST:RANG5:XCO?`
would return, e.g.
`100`

Usage: Query only

Manual operation: See "Working with the half decade configuration table" on page 107

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of measurements that the application uses to average traces.

In case of continuous measurement mode, the application calculates the moving average over the average count.

In case of single measurement mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> When you set a sweep count of 0 or 1, the R&S FSWP performs one single measurement in single measurement mode.
In continuous measurement mode, if the sweep count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

Example: `SWE:COUN 64`
Sets the number of measurements to 64.
`INIT:CONT OFF`
Switches to single measurement mode.
`INIT;*WAI`
Starts a measurement and waits for its end.

Usage: SCPI confirmed

Manual operation: See "Sweep / Average Count" on page 106

[SENSe:]SWEep:TIME?

This command queries the estimated measurement time.

Return values:

<Time> <numeric value>

Default unit: s

Example: `SWE:TIME?`
would return, e.g.
`0.050432`

Usage: Query only

Manual operation: See "Estimating the measurement time" on page 107

[SENSe:]SWEep:XFACtor <Factor>

This command defines the cross-correlation factor (XCORR factor) that defines the cross-correlation operations in each half decade.

Parameters:

<Factor> <numeric value>

Range: 1

Example: `SWE:XFAC 10`
Defines a XCORR factor of 10.

Manual operation: See "Defining cross-correlation parameters" on page 105

[SENSe:]SWEep:XOPTimize <State>

This command turns optimization of the cross-correlation operations on and off.

Parameters:

<State> ON | OFF

*RST: ON

Example: `SWE:XOPT OFF`
Turns off optimization (always performs the full number of operations).

Manual operation: See "Defining cross-correlation parameters" on page 105

12.6.5.2 Residual Calculation Configuration

CALCulate<n>[:RANGe<r>]:EVALuation:STARt....321
CALCulate<n>[:RANGe<r>]:EVALuation:STOP....322
CALCulate<n>[:RANGe<r>]:EVALuation:TRACe....322
CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]....323
CALCulate<n>[:RANGe<r>]:EVALuation:WEIGhting....323
[SENSe:]CORRection:WEIGhting:COMMent....323
[SENSe:]CORRection:WEIGhting:DATA....324
[SENSe:]CORRection:WEIGhting:DELete....324
[SENSe:]CORRection:WEIGhting:NAME....324
[SENSe:]CORRection:WEIGhting:SELect....325

CALCulate<n>[:RANGe<r>]:EVALuation:STARt <Frequency>

This command defines the start frequency of a custom integration range for residual effects calculation.

The command is available when you turn off integration over the complete measurment range with `CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]`.

Suffix:
<r> 1...4
Selects the range.

Parameters:
<Frequency> <numeric value>
Range: Depends on the measurement range.
*RST: 1 MHz
Default unit: Hz

Example: See `CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]`.

Manual operation: See "Defining the integration range" on page 108

CALCulate<n>[:RANGe<r>]:EVALuation:STOP <Frequency>

This command defines the stop frequency of a custom integration range for residual effects calculation.

The command is available when you turn off integration over the complete measurment range with `CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]`.

Suffix:
<r> 1...4
Selects the range.

Parameters:
<Frequency> <numeric value>
Range: Depends on the measurement range.
*RST: 1 kHz
Default unit: Hz

Example: See `CALCulate<n>[:RANGe<r>]:EVALuation[:STATe]`.

Manual operation: See "Defining the integration range" on page 108

CALCulate<n>[:RANGe<r>]:EVALuation:TRACe <Trace1>

This command selects the trace for calculation of residual effects.

Suffix:
<r> 1...4
Selects the range.

Parameters:
<Trace1> **TRACE1 | ... | TRACE6**
Selects the trace. You can select a trace that is inactive, but for residual effect calculation, it must be active.

NONE
Turns off residual calculation for the respective range.

*RST: Depends on the range.

Example: `CALC:RANG2:EVAL:TRAC TRACE1`
Uses trace 1 as the data source for range 2.

Manual operation: See "Selecting the trace for residual calculations" on page 108

CALCulate<n>[:RANGe<r>]:EVALuation[:STATe] <State>

This command turns integration of the entire measurement range for residual calculations on and off.

Suffix:
<r> 1...4
Selects the range.

Parameters:
<State> **ON**
Integrates over the complete measurement range.

OFF
Integrates over a custom measurement range.

Example:
```
CALC:RANG2:EVAL OFF
CALC:RANG2:EVAL:STAR 100000
CALC:RANG2:EVAL:STOP 300000
```
Defines an integration range from 1 kHz to 3 kHz in range 2.

Manual operation: See "Defining the integration range" on page 108

CALCulate<n>[:RANGe<r>]:EVALuation:WEIGhting <Name>

This command selects a weighting filter whose values are applied to the calculation of residual effects.

Suffix:
<r> 1...4
Selects the range.

Setting parameters:
<Name> String containing the name of the filter.

*RST: NONE

Example: `CALC:RANG1:EVAL:WEIG 'A FILTER'`
Applies a filter called "A Filter" to the residual calculations in integration range 1.

Manual operation: See "Applying weighting filters" on page 108

[SENSe:]CORRection:WEIGhting:COMMent <Name>

This command defines a comment for a weighting filter whose values are applied to the calculation of residual effects.

Setting parameters:
<Name> String containing the comment.

Example: See [SENSe:]CORRection:WEIGhting:NAME on page 324.

Manual operation: See "Designing weighting filters" on page 109

[SENSe:]CORRection:WEIGhting:DATA {<freq>, <level>}...

This command defines the shape of the weighting filter whose values are applied to the calculation of residual effects.

The shape of the weighting filter is defined by two or more pairs of frequency and level values.

Parameters:

<Frequency> <numeric value>
Default unit: Hz

<Level> <numeric value>
Default unit: dB

Example: See [SENSe:]CORRection:WEIGhting:NAME on page 324.

Manual operation: See "Designing weighting filters" on page 109

[SENSe:]CORRection:WEIGhting:DELete

This command deletes the currently selected weighting filter.

Select a weighting filter with [SENSe:]CORRection:WEIGhting:SELect on page 325.

Example:
```
CORR:WEIG:DEL
```
Deletes the currently selected weighting filter.

Usage: Event

Manual operation: See "Managing weighting filters" on page 109

[SENSe:]CORRection:WEIGhting:NAME <Name>

This command defines the name for a weighting filter whose values are applied to the calculation of residual effects.

Setting parameters:

<Name> String containing the name of the filter.

Example:
```
CORR:WEIG:NAME 'FILTER'
CORR:WEIG:COMM 'Here's an example for a filter.'
CORR:WEIG:DATA 10MHZ,0DB,20MHZ,2DB,40MHZ,5DB
```
Creates a weighting filter called "FILTER", with a comment and a few data points.

Manual operation: See "Designing weighting filters" on page 109

[SENSe:]CORRection:WEIGhting:SELect <Name>

This command selects a weighting filter whose values are applied to the calculation of residual effects.

Setting parameters:

<Name> String containing the name of the weighting filter.

Example: `CORR:WEIG:SEL 'FILTER'`
Selects a weighting filter called "filter".

Manual operation: See "Managing weighting filters" on page 109

12.6.5.3 Spot Noise Configuration

CALCulate<n>:SNOise<m>:AOFF 325
CALCulate<n>:SNOise<m>:STATe 325
CALCulate<n>:SNOise<m>:X 326
CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:X? 326
CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:Y? 326
CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades[:STATe] 327
CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe] 327
CALCulate<n>:SNOise<m>[:TRACe<t>]:Y? 328
DISPlay:SNINfo[:STATe] 328
DISPlay:SNINfo:TRACe 328

CALCulate<n>:SNOise<m>:AOFF

This command turns all spot noise information off (custom and 10^x information).

Suffix:

<m> 1...6
irrelevant

Example: `CALC:SNO:AOFF`
Turns off all spot noise information.

Usage: Event

CALCulate<n>:SNOise<m>:STATe <State>

This command turns a custom spot noise position on and off.

Suffix:

<m> 1...6
Selects the spot noise marker.

Parameters:

<State> ON | OFF
*RST: All ON

Example: See `CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe]`.

CALCulate<n>:SNOise<m>:X <Frequency>...

This command defines the horizontal position of a custom spot noise position.

Suffix:
<m> 1...6
Selects the spot noise marker.

Parameters:
<Frequency> For minimum and maximum offsets, refer to the data sheet. The default values are the decade edges (1 kHz, 10 kHz etc.)
Default unit: Hz

Example: See `CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe]`.

CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:X?

This command queries the horizontal position of the 10^x offset frequency spot noise information.

Suffix:
<m> irrelevant

Return values:
<Frequency> List of offset frequencies, one for each 10^x spot noise position. The number of return values depends on the measurement range.
Default unit: Hz

Example:
```
CALC:SNO:DEC:X?
```
would return, e.g.
```
1000,10000,100000,1000000
```

Usage: Query only

Manual operation: See "Spot Noise" on page 93

CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades:Y?

This command queries the vertical position of the 10^x offset frequency spot noise information.

Suffix:
<n> 1..n
<m> 1..n
irrelevant
<t> 1..n

Return values:

<Level> List of phase noise level values, one for each 10^x spot noise positions.
The number of return values depends on the measurement range.
Default unit: dBc/Hz

Example: `CALC:SNO:DEC:Y?`
would return, e.g.
`-152.560974121094,-136.443389892578,`
`-145.932891845703,-152.560974121094`

Usage: Query only

Manual operation: See "Spot Noise" on page 93

CALCulate<n>:SNOise<m>[:TRACe<t>]:DECades[:STATe] <State>

This command turns the spot noise calculation on every 10^x offset frequency on and off.

Suffix:

<m> irrelevant

Parameters:

<State> ON | OFF
*RST: ON

Example: `CALC:SNO:DEC ON`
Turns on the spot noise calculation for all decade edges.

CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe] <State>

This command turns calculation of custom spot noise positions on and off

Suffix:

<m> irrelevant

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:SNO:USER ON`
Turns on user defined spot noise positions.
`CALC:SNO3:STAT ON`
`CALC:SNO3:X 500000`
Turns on custom spot noise marker 2 at an offset of 500 kHz.
`CALC:SNO3:Y?`
would return, e.g.
`-90.1154022217`

CALCulate<n>:SNOise<m>[:TRACe<t>]:Y?

This command queries the level measured for a custom spot noise position.

The command is available when `CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe]` has been turned off.

Suffix:

<n> 1..n

<m> 1..n
Selects the spot noise marker.

<t> 1..n

Return values:

<Level> Phase noise level at the spot noise position.
Default unit: dBc/Hz

Example: See `CALCulate<n>:SNOise<m>[:TRACe<t>]:USERdefined[:STATe]`.

Usage: Query only

Manual operation: See "Spot Noise" on page 93

DISPlay:SNINfo[:STATe] <State>

This command turns the display of spot noise information in the diagram area on and off.

Parameters:

<State> ON | OFF
*RST: ON

Example: `DISP:SNIN ON`
Displays the spot noise information.

Manual operation: See "Displaying spot noise information" on page 110

DISPlay:SNINfo:TRACe <Trace>

This command selects the trace for which spot noise information is evaluated.

Parameters:

<Trace> Range: 1 to 6
*RST: 1

Example: `DISP:SNIN:TRAC 2`
Evaluates the spot noise for trace 2.

Manual operation: See "Displaying spot noise information" on page 110

12.6.6 Pulsed Phase Noise Configuration

[SENSe:]SWEep:EGATe:HOLDoff....329
[SENSe:]SWEep:EGATe:LENGth....329
[SENSe:]SWEep:EGATe:LEVel....330
[SENSe:]SWEep:EGATe:TYPE....330
[SENSe:]SWEep:PULSe:DETection....330
[SENSe:]SWEep:PULSe:PRI....331

[SENSe:]SWEep:EGATe:HOLDoff <GateDelay>

This command defines the gate delay time.

The command is available when you have turned off automatic pulse detection with `[SENSe:]SWEep:PULSe:DETection`.

Available for the optional pulsed phase noise measurement application.

Parameters:

<GateDelay> <numeric value>

*RST: Automatic pulse detection is on.
Default unit: s

Example:

```
SWE:PULS:DET MAN
SWE:EGAT:HOLD 10us
```

Defines a gate delay of 10 µs.

Manual operation: See "Defining the shape of the gate" on page 119

[SENSe:]SWEep:EGATe:LENGth <Length>

This command defines the gate length.

The command is available when you have turned off automatic pulse detection with `[SENSe:]SWEep:PULSe:DETection` and when you have selected the "EDGE" gate mode with `[SENSe:]SWEep:EGATe:TYPE`.

Available for the optional pulsed phase noise measurement application.

Parameters:

<Length> <numeric value>

*RST: Automatic pulse detection is on.
Default unit: s

Example:

```
SWE:PULS:DET MAN
SWE:EGAT:TYPE EDGE
SWE:EGAT:LENG 200us
```

Defines a gate length of 200 µs.

Manual operation: See "Defining the shape of the gate" on page 119

[SENSe:]SWEep:EGATe:LEVel <Level>

This command defines the gate level.

The command is available when you have turned off automatic pulse detection with `[SENSe:]SWEep:PULSe:DETection`.

Available for the optional pulsed phase noise measurement application.

Parameters:

<Level> <numeric value>

*RST: Automatic pulse detection is on.
Default unit: dBm

Example:
```
SWE:PULS:DET MAN
SWE:EGAT:LEV -10
```
Defines a gate level of -10 dBm.

Manual operation: See "Defining the shape of the gate" on page 119

[SENSe:]SWEep:EGATe:TYPE <GateType>

This command selects the gate type.

Available for the optional pulsed phase noise measurement application.

Parameters:

<GateType>

EDGE
The gate opens when the gate level has been exceeded and closes when the time defined by the gate length has elapsed.

LEVel
The gate opens when the gate level has been exceeded and closes when the signal level again falls below the gate level.

OFF
The gate is off.

Example:
```
SWE:EGAT:TYPE EDGE
```
Selects gate type "EDGE".

Manual operation: See "Selecting the gate type" on page 118

[SENSe:]SWEep:PULSe:DETection <Mode>

This command selects the pulse detection mode.

Available for the optional pulsed phase noise measurement application.

Parameters:

<Mode>

AUTO
Initiates an automatic detection of the pulse characteristics with a subsequent configuration of the gate before you start a measurement.

MANual
Allows you to manually configure the pulse measurement characteristics.

ONCE
Initiates an immediate, automatic detection of the pulse characteristics with a subsequent configuration of the gate.

Example:
```
SWE:PULS:DET AUTO
```
Configure the measurement based on the detected pulse.

Manual operation: See "Selecting the pulse detection mode" on page 118

[SENSe:]SWEep:PULSe:PRI <Time>

This command defines the pulse repetition interval.

The command is available when you have turned off automatic pulse detection with `[SENSe:]SWEep:PULSe:DETection`.

Available for the optional pulsed phase noise measurement application.

Parameters:

<Time>

<numeric value>

*RST: Automatic pulse detection is on.
Default unit: s

Example:
```
SWE:PULS:DET MAN
SWE:PULS:PRI 500US
```
Defines a pulse repetition interval of 500 µs.

Manual operation: See "Defining the pulse repetition interval" on page 118

12.7 Common Analysis and Display Functions

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12.7.1 Display Configuration

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LAYout:WINDow<n>:ADD? 337
LAYout:WINDow<n>:IDENtify? 337
LAYout:WINDow<n>:REMove 338
LAYout:WINDow<n>:REPLace 338

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay:WSELect?

This command queries the currently active window (the one that is focused) *in the currently selected measurement channel*.

Return values:

<ActiveWindow> Index number of the currently active window.

Range: 1 to 16

Usage: Query only

DISPlay[:WINDow<n>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: `DISP:WIND1:SEL`
Sets the window 1 active.

Usage: Setting only

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 335).

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:LARG`

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName>

String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction>

LEFT | RIGHt | ABOVe | BELow

Direction the new window is added relative to the existing window.

<WindowType>

text value

Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName>

When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

```
LAY:ADD? '1',LEFT,MTAB
```

Result:

```
'2'
```

Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation: See "Marker Table" on page 93

Table 12-2: <WindowType> parameter values for the Spectrum application

Parameter value	Window type
DIAGram	Diagram
MTABle	Marker Table
RNO	Residual Noise Calculations
SNO	Spot Noise
SPUR	Spurious List

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: LAY:WIND:IDEN? '2'
Queries the index of the result display named '2'.
Response:
2

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Example: LAY:REM '2'
Removes the result display in the window named '2'.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the LAYout:ADD[:WINDow]? command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the LAYout:CATalog[:WINDow]? query.

<WindowType> Type of result display you want to use in the existing window.
See LAYout:ADD[:WINDow]? on page 333 for a list of available window types.

Example: LAY:REPL:WIND '1',MTAB
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Compared to the DISPlay[:WINDow<n>]:SIZE on page 333 command, the LAYout:SPLitter changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

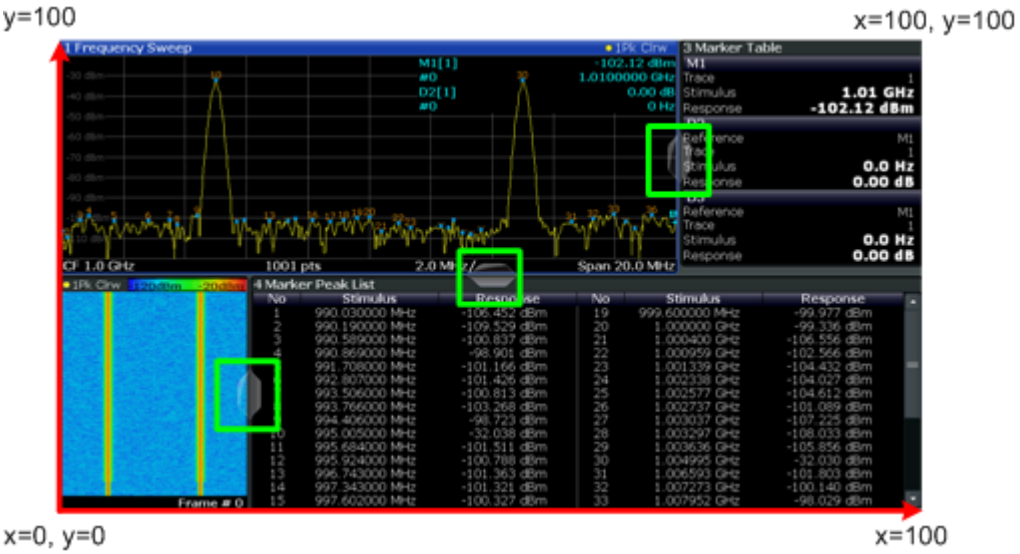


Fig. 12-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See figure 12-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 333 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: LAY:WIND2:IDEN?
Queries the name of the result display in window 2.
Response:
'2'

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the LAYout:REMove[:WINDow] command.

Example: LAY:WIND2:REM
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result of this command is identical to the LAYout:REPLace[:WINDow] command.

To add a new window, use the LAYout:WINDow<n>:ADD? command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See LAYout:ADD[:WINDow]? on page 333 for a list of available window types.

Example: LAY:WIND2:REPL MTAB
Replaces the result display in window 2 with a marker table.

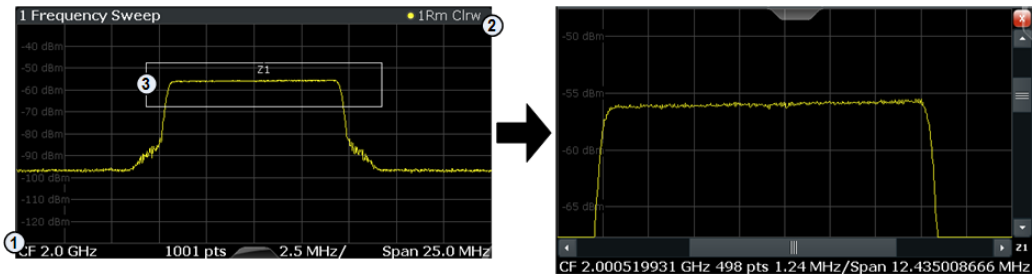
12.7.2 Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA 338
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA 339
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe 340
DISPlay[:WINDow<n>]:ZOOM:STATe 340

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

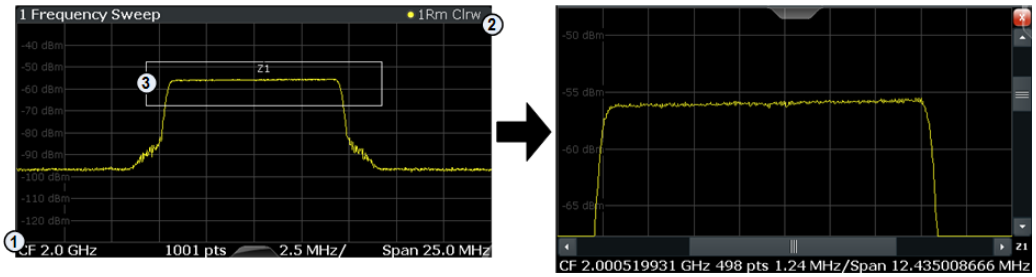
Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 126

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom>

1...4
Selects the zoom window.

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multiple Zoom" on page 126

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:
<zoom> 1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Multiple Zoom" on page 126

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `DISP:ZOOM ON`
Activates the zoom mode.

Manual operation: See "Single Zoom" on page 126
See "Restore Original Display" on page 127
See "Deactivating Zoom (Selection mode)" on page 127

12.7.3 Trace Configuration

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12.7.3.1 Trace Characteristics

DISPlay[:WINDow<n>]:TRACe<t>:MODE....341
DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe]....342
DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT....342
DISPlay[:WINDow<n>]:TRACe<t>:RESult[:TYPE]....342
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet....343
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet:STATe....343
DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture....343

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] 344
DISPlay[:WINDow<n>]:TRACe<t>:SPURs:SUPPress 344
DISPlay[:WINDow<n>]:TRACe<t>:SPURs:THReshold 344

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNt`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSWP saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSWP saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

WRHold
The trace is overwritten when new data is available, but only after all cross-correlation operations defined for a half decade are done.

*RST: Depends on the trace.

Example:

```
INIT:CONT OFF
```
Switching to single sweep mode.
```
SWE:COUN 16
```
Sets the number of measurements to 16.
```
DISP:TRAC3:MODE WRIT
```
Selects clear/write mode for trace 3.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 133

DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe] <State>

This command turns the display of the trace label for a specific trace on and off.

The command can only be applied to active traces.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<State> ON | OFF

*RST: OFF

Example: `DISP:TRAC2:LAB ON`
Turns on the label for trace 2.

DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT <Label>

This command defines the contents of a trace label.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Label> String containing the trace label.

Example: `DISP:TRAC2:LAB:TEXT 'A YELLOW TRACE'`
Assigns the label "A Yellow Trace" to trace 2.

DISPlay[:WINDow<n>]:TRACe<t>:RESult[:TYPE] <Resulttype>

This command selects the type of noise represented by the trace.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Resulttype>

PN
Phase noise results.

AM
AM noise results.

PNAM
Sum of phase noise and AM noise.

Example: `DISP:TRAC2:RES AM`
Trace 2 shows the AM noise characteristics.

Manual operation: See "Selecting the displayed result" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Offset> Default unit: DB

Manual operation: See "Shifting the trace" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet:STATe <State>

This command turns the offset for a trace on and off.

When you turn that feature on, the trace is shifted vertically by a certain amount.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<State> ON | OFF

*RST: OFF

Example:
```
DISP:TRAC2:Y:RLEV:OFFS:STAT ON
DISP:TRAC2:Y:RLEV:OFFS 10
```
Shifts trace 2 vertically by 10 dB.

Manual operation: See "Shifting the trace" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture <Aperture>

This command defines the magnitude (aperture) of trace smoothing.

The command is available when you have turned on trace smoothing with `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]`.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Aperture> <numeric value>

Range: 1 to 20
*RST: 1
Default unit: PCT

Example: See `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]`.

Manual operation: See "Smoothing traces" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe] <State>

This command turns trace smoothing for a specific trace on and off.

When you turn on trace smoothing, you can define the smoothing magnitude with `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing:APERture`.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<State> ON | OFF

*RST: Depends on the trace.

Example:
```
DISP:TRAC3:MODE AVER
SWE:COUN 10
DISP:TRAC3:RES AM
```
Turns on trace 3 (average mode based on 10 measurements) to display the AM noise results.
```
DISP:TRAC3:SMO ON
DISP:TRAC3:SMO:APER 10
```
Smoothes the trace by a magnitude of 10 %.
```
DISP:TRAC3:SPUR:SUPP ON
DISP:TRAC3:SPUR:THR 5
```
Removes spurs from trace 3.

Manual operation: See "Smoothing traces" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:SPURs:SUPPress <State>

This command turns spur removal for a specific trace on and off.

When you turn on spur removal, you can define a level threshold with `DISPlay[:WINDow<n>]:TRACe<t>:SPURs:THReshold`.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<State> ON | OFF

*RST: OFF

Example: See `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]`.

Manual operation: See "Removing spurs" on page 134

DISPlay[:WINDow<n>]:TRACe<t>:SPURs:THReshold <Threshold>

This command defines a level threshold for spur removal.

The command is available when you hvae turned on spur removal on a specific trace with `DISPlay[:WINDow<n>]:TRACe<t>:SPURs:THReshold`.

Suffix:
<n> 1..n

<t> 1..n

Parameters:
<Threshold> <numeric value>

*RST: 0
Default unit: dB

Example: See `DISPlay[:WINDow<n>]:TRACe<t>:SMOothing[:STATe]`.

Manual operation: See "Removing spurs" on page 134

12.7.3.2 Trace Copy

TRACe<n>:COPY 345

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

This command copies data from one trace to another.

Parameters:
<TraceNumber>, <TraceNumber> **TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6**
The first parameter is the destination trace, the second parameter is the source.
(Note the 'e' in the parameter is required!)

Example: `TRAC:COPY TRACE1,TRACE2`
Copies the data from trace 2 to trace 1.

Usage: SCPI confirmed

12.7.3.3 Trace Export

FORMat[:DATA] 345
FORMat:DEXPort:DSEParator 346
FORMat:DEXPort:HEADer 346
FORMat:DEXPort:TRACes 347

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSWP to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSWP. The R&S FSWP automatically recognizes the data it receives, regardless of the format.

For details on data formats see chapter 12.7.3.5, "Formats for Returned Values: ASCII Format and Binary Format", on page 348.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
The format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 136

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Usage: SCPI confirmed

Manual operation: See "Include Instrument Measurement Settings" on page 135

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 393).

Parameters:

<Selection>

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Usage: SCPI confirmed

Manual operation: See "Export all Traces and all Table Results" on page 135

12.7.3.4 Trace Mathematics

CALCulate<n>:MATH:STATe....347
CALCulate<n>:MATH[:EXPRession][:DEFine]....348

CALCulate<n>:MATH:STATe <State>

This command turns trace mathematics on and off.

Suffix:

<n> 1..n

Parameters:

<State>

ON
Turns trace mathematics on and selects the operation that has been selected last (or `(TRACE1-TRACE3)` if you have not yet selected one).

OFF
Turns trace mathematics off.

Example:

```
DISP:TRAC3:MODE WRIT
CALC:MATH (TRACE2-TRACE3)
```
Turns on trace 3, subtracts it from trace 2 and writes the result to trace 2.

```
CALC:MATH:STAT OFF
```
Turns off trace mathematics.

```
CALC:MATH:STAT ON
```
Turns them on again and selects the operation (TRACE2-TRACE3).

Manual operation: See "Selecting the math operation" on page 136

CALCulate<n>:MATH[:EXPRession][:DEFine] <Operation>

This command selects the operation for trace mathematics.

Suffix:
<n> 1..n

Setting parameters:
<Operation> Depending on the operation you select, one trace is subtracted from another. The result is written to the first trace indicated in the operation.
An operation is only available if both traces are actually turned on.

(TRACE1-TRACE3)

(TRACE2-TRACE3)

(TRACE4-TRACE6)

(TRACE5-TRACE6)

*RST: Trace mathematics are off.

Example: `CALC:MATH (TRACE1-TRACE2)`
Subtracts trace 2 from trace 1 and writes the result to trace 1.

Manual operation: See "Selecting the math operation" on page 136

12.7.3.5 Formats for Returned Values: ASCII Format and Binary Format

When trace data is retrieved using the `TRAC:DATA` or `TRAC:IQ:DATA` command, the data is returned in the format defined using the `FORMat[:DATA]`. The possible formats are described here.

- ASCII Format (FORMat ASCII):
  The data is stored as a list of comma separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,32):
  The data is stored as binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating-Point-Format.
  The schema of the result string is as follows:
  `#41024<value1><value2>…<value n>` with

#4	number of digits (= 4 in the example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the example)
<Value>	4-byte floating point value

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

12.7.4 Marker

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12.7.4.1 Individual Marker Setup

CALCulate<n>:DELTamarker<m>:AOFF 349
CALCulate<n>:DELTamarker<m>:LINK 349
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> 350
CALCulate<n>:DELTamarker<m>:MODE 350
CALCulate<n>:DELTamarker<m>:MREF 350
CALCulate<n>:DELTamarker<m>[:STATe] 350
CALCulate<n>:DELTamarker<m>:TRACe 351
CALCulate<n>:DELTamarker<m>:X 351
CALCulate<n>:MARKer<m>:AOFF 351
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> 352
CALCulate<n>:MARKer<m>[:STATe] 352
CALCulate<n>:MARKer<m>:TRACe 352
CALCulate<n>:MARKer<m>:X 352

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

(<m> is irrelevant)

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT2:LINK ON`

Manual operation: See "Linking to Another Marker" on page 142

CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 142

CALCulate<n>:DELTamarker<m>:MODE <Mode>

This command defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker (for *all* delta markers, <m> is irrelevant).

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see `CALCulate<n>:DELTamarker<m>:X` on page 351)!

Parameters:

<Mode>

ABSolute
Delta marker position in absolute terms.

RELative
Delta marker position in relation to a reference marker.

*RST: RELative

Example: `CALC:DELT:MODE ABS`
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

Parameters:

<Reference>

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 141

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:DELT2 ON
Turns on delta marker 2.

Manual operation: See "Marker State" on page 141
See "Marker Type" on page 141

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace> Trace number the marker is assigned to.

Example: CALC:DELT2:TRAC 2
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: CALC:DELT:X?
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker Position (X-value)" on page 141

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: CALC:MARK:AOFF
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 142

CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 142

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 141
See "Marker Type" on page 141

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:
<Trace>

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See "Assigning the Marker to a Trace" on page 142

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis. The unit is Hz.

Range: The range depends on the current x-axis range.

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 93
See "Marker Position (X-value)" on page 141

12.7.4.2 General Marker Settings

DISPlay:MTABle 353
CALCulate<n>:MARKer<m>:LINK 353

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode> **ON**
Turns the marker table on.

OFF
Turns the marker table off.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 143

CALCulate<n>:MARKer<m>:LINK <State>

This command defines whether all markers within the selected result display are linked. If enabled, and you move one marker along the x-axis, all other markers in the display are moved to the same x-axis position.

(The suffix <m> is irrelevant.)

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC2:MARK:LINK ON`

Manual operation: See "Linked Markers" on page 143

12.7.4.3 Marker Search

CALCulate<n>:MARKer<m>:PEXCursion 354

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

This command defines the peak excursion (for *all* markers in *all* windows; <m>, <n> are irrelevant).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Manual operation: See "Peak Excursion" on page 144

12.7.4.4 Positioning Markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT 354
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT 354
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt 355
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] 355
CALCulate<n>:DELTamarker<m>:MINimum:LEFT 355
CALCulate<n>:DELTamarker<m>:MINimum:NEXT 355
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt 355
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] 355
CALCulate<n>:MARKer<m>:MAXimum:AUTO 356
CALCulate<n>:MARKer<m>:MAXimum:LEFT 356
CALCulate<n>:MARKer<m>:MAXimum:NEXT 356
CALCulate<n>:MARKer<m>:MAXimum:RIGHt 356
CALCulate<n>:MARKer<m>:MAXimum[:PEAK] 356
CALCulate<n>:MARKer<m>:MINimum:AUTO 357
CALCulate<n>:MARKer<m>:MINimum:LEFT 357
CALCulate<n>:MARKer<m>:MINimum:NEXT 357
CALCulate<n>:MARKer<m>:MINimum:RIGHt 357
CALCulate<n>:MARKer<m>:MINimum[:PEAK] 357

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 144

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 145

CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>

This command turns an automatic marker peak search for a trace maximum on and off. The R&S FSWP performs the peak search after each sweep.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:MAX:AUTO ON`
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Peak" on page 145

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 144

CALCulate<n>:MARKer<m>:MINimum:AUTO <State>

This command turns an automatic marker peak search for a trace minimum on and off. The R&S FSWP performs the peak search after each sweep.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:MIN:AUTO ON`
Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Next Minimum" on page 145

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 145

12.7.4.5 Retrieving Marker Positions

Commands useful to retrieve marker positions described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 351
- `CALCulate<n>:MARKer<m>:X` on page 352

CALCulate<n>:DELTamarker<m>:X:RELative?....358
CALCulate<n>:DELTamarker<m>:Y?....358
CALCulate<n>:MARKer<m>:Y?....359

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

The unit depends on the application of the command.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Return values:

<Result> Result at the marker position.

Example:

```
INIT:CONT OFF
```
Switches to single measurement mode.
```
CALC:MARK2 ON
```
Switches marker 2.
```
INIT;*WAI
```
Starts a measurement and waits for the end.
```
CALC:MARK2:Y?
```
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 93

12.7.5 Limit Lines

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12.7.5.1 Configuring Limit Lines

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Managing Limit Lines

CALCulate<n>:LIMit<k>:ACTive?....360
CALCulate<n>:LIMit<k>:CONTrol:OFFSet....360
CALCulate<n>:LIMit<k>:COPY....360
CALCulate<n>:LIMit<k>:DELete....360
CALCulate<n>:LIMit<k>:LOWer:OFFSet....361
CALCulate<n>:LIMit<k>:LOWer:STATe....361
CALCulate<n>:LIMit<k>:STATe....361
CALCulate<n>:LIMit<k>:TRACe....361
CALCulate<n>:LIMit<k>:TRACe<t>:CHECk....362
CALCulate<n>:LIMit<k>:UPPer:OFFSet....362
CALCulate<n>:LIMit<k>:UPPer:STATe....362

CALCulate<n>:LIMit<k>:ACTive?

This command queries the names of *all* active limit lines (<n>, <k> are irrelevant).

Return values:

<LimitLines> String containing the names of all active limit lines in alphabetical order.

Example: `CALC:LIM:ACT?`
Queries the names of all active limit lines.

Usage: Query only

Manual operation: See "Visibility" on page 150

CALCulate<n>:LIMit<k>:CONTrol:OFFSet <Offset>

This command defines an offset for a complete limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

(<n> is irrelevant.)

Parameters:

<Offset> Numeric value.
The unit depends on the scale of the x-axis.
*RST: 0

CALCulate<n>:LIMit<k>:COPY <Line>

This command copies a limit line.

Parameters:

<Line> **1 to 8**
number of the new limit line
<name>
String containing the name of the limit line.

Example: `CALC:LIM1:COPY 2`
Copies limit line 1 to line 2.
`CALC:LIM1:COPY 'FM2'`
Copies limit line 1 to a new line named FM2.

Manual operation: See "Copy Line" on page 151

CALCulate<n>:LIMit<k>:DELete

This command deletes a limit line.

Usage: Event

Manual operation: See "Delete Line" on page 151

CALCulate<n>:LIMit<k>:LOWer:OFFSet <Offset>

This command defines an offset for a complete lower limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Parameters:

<Offset> Numeric value.

*RST: 0
Default unit: dB

CALCulate<n>:LIMit<k>:LOWer:STATe <State>

This command turns a lower limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<k>:NAME` on page 366.

(<n> is irrelevant.)

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual operation: See "Visibility" on page 150

CALCulate<n>:LIMit<k>:STATe <State>

This command turns the limit check for a specific limit line on and off.

To query the limit check result, use `CALCulate<n>:LIMit<k>:FAIL?`.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see `CALCulate<n>:LIMit<k>:TRACe<t>:CHECk` on page 362).

(<n> is irrelevant.)

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Usage: SCPI confirmed

Manual operation: See "Disable All Lines" on page 151

CALCulate<n>:LIMit<k>:TRACe <TraceNumber>

This command links a limit line to one or more traces.

Note that this command is maintained for compatibility reasons only. Limit lines no longer need to be assigned to a trace explicitely. The trace to be checked can be defined directly (as a suffix) in the new command to activate the limit check (see CALCulate<n>:LIMit<k>:TRACe<t>:CHECk on page 362).

Example: CALC:LIM2:TRAC 3
Assigns limit line 2 to trace 3.

CALCulate<n>:LIMit<k>:TRACe<t>:CHECk <State>

This command turns the limit check for a specific trace on and off.

To query the limit check result, use CALCulate<n>:LIMit<k>:FAIL?.

Note that this command replaces the two commands from previous signal and spectrum analyzers (which are still supported, however):

- CALCulate<n>:LIMit<k>:TRACe on page 361
- CALCulate<n>:LIMit<k>:STATe on page 361

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:LIM3:TRAC2:CHEC ON
Switches on the limit check for limit line 3 on trace 2.

Manual operation: See "Traces to be Checked" on page 150

CALCulate<n>:LIMit<k>:UPPer:OFFSet <Offset>

This command defines an offset for a complete upper limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

(<n> is irrelevant.)

Parameters:
<Offset> Numeric value.
*RST: 0
Default unit: dB

CALCulate<n>:LIMit<k>:UPPer:STATe <State>

This command turns an upper limit line on and off.

Before you can use the command, you have to select a limit line with CALCulate<n>:LIMit<k>:NAME on page 366.

(<n> is irrelevant.)

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual operation: See "Visibility" on page 150

Designing Limit Lines

CALCulate<n>:LIMit<k>:COMMent 363
CALCulate<n>:LIMit<k>:CONTrol[:DATA] 363
CALCulate<n>:LIMit<k>:CONTrol:DOMain 364
CALCulate<n>:LIMit<k>:CONTrol:MODE 364
CALCulate<n>:LIMit<k>:CONTrol:SHIFt 364
CALCulate<n>:LIMit<k>:CONTrol:SPACing 365
CALCulate<n>:LIMit<k>:LOWer[:DATA] 365
CALCulate<n>:LIMit<k>:LOWer:MARGin 365
CALCulate<n>:LIMit<k>:LOWer:MODE 365
CALCulate<n>:LIMit<k>:LOWer:SHIFt 366
CALCulate<n>:LIMit<k>:LOWer:SPACing 366
CALCulate<n>:LIMit<k>:LOWer:THReshold 366
CALCulate<n>:LIMit<k>:NAME 366
CALCulate<n>:LIMit<k>:UNIT 367
CALCulate<n>:LIMit<k>:UPPer[:DATA] 367
CALCulate<n>:LIMit<k>:UPPer:MARGin 367
CALCulate<n>:LIMit<k>:UPPer:MODE 367
CALCulate<n>:LIMit<k>:UPPer:SHIFt 368
CALCulate<n>:LIMit<k>:UPPer:SPACing 368
CALCulate<n>:LIMit<k>:UPPer:THReshold 368

CALCulate<n>:LIMit<k>:COMMent <Comment>

This command defines a comment for a limit line.

(<n> is irrelevant.)

Parameters:

<Comment> String containing the description of the limit line. The comment may have up to 40 characters.

Manual operation: See "Comment" on page 152

CALCulate<n>:LIMit<k>:CONTrol[:DATA] <LimitLinePoints>

This command defines the horizontal definition points of a limit line.

(<n> is irrelevant.)

Parameters:

<LimitLinePoints> Variable number of x-axis values.
Note that the number of horizontal values has to be the same as the number of vertical values set with `CALCulate<n>:LIMit<k>:LOWer[:DATA]` or `CALCulate<n>:LIMit<k>:UPPer[:DATA]`. If not, the R&S FSWP either adds missing values or ignores surplus values.

*RST: -

Usage: SCPI confirmed

Manual operation: See "Data points" on page 152

CALCulate<n>:LIMit<k>:CONTrol:DOMain <SpanSetting>

This command selects the domain of the limit line.

(<n> is irrelevant.)

Parameters:

<SpanSetting> FREQuency | TIME

*RST: FREQuency

CALCulate<n>:LIMit<k>:CONTrol:MODE <Mode>

This command selects the horizontal limit line scaling.

(<n> is irrelevant.)

Parameters:

<Mode> **ABSolute**
Limit line is defined by absolute physical values (Hz or s).

RELative
Limit line is defined by relative values related to the center frequency (frequency domain) or the left diagram border (time domain).

*RST: ABSolute

CALCulate<n>:LIMit<k>:CONTrol:SHIFt <Distance>

This command moves a complete limit line horizontally.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

(<n> is irrelevant.)

Parameters:

<Distance> Numeric value.
The unit depends on the scale of the x-axis.

Manual operation: See "Shift x" on page 152

CALCulate<n>:LIMit<k>:CONTrol:SPACing <InterpolMode>

This command selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Parameters:

<InterpolMode> LINear | LOGarithmic

*RST: LIN

Example: `CALC:LIM:CONT:SPAC LIN`

CALCulate<n>:LIMit<k>:LOWer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of a lower limit line.

(<n> is irrelevant.)

Parameters:

<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<k>:CONTrol[:DATA]`. If not, the R&S FSWP either adds missing values or ignores surplus values.

*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual operation: See "Data points" on page 152

CALCulate<n>:LIMit<k>:LOWer:MARGin <Margin>

This command defines an area around a lower limit line where limit check violations are still tolerated.

(<n> is irrelevant.)

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

CALCulate<n>:LIMit<k>:LOWer:MODE <Mode>

This command selects the vertical limit line scaling.

Parameters:

<Mode>

ABSolute
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

CALCulate<n>:LIMit<k>:LOWer:SHIFt <Distance>

This command moves a complete lower limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Parameters:

<Distance> Defines the distance that the limit line moves.

Manual operation: See "Shift y" on page 153

CALCulate<n>:LIMit<k>:LOWer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of a lower limit line from one horizontal point to the next.

Parameters:

<InterpolType> LINear | LOGarithmic

*RST: LIN

Manual operation: See "Y-Axis" on page 152

CALCulate<n>:LIMit<k>:LOWer:THReshold <Threshold>

This command defines a threshold for relative limit lines.

The R&S FSWP uses the threshold for the limit check, if the limit line violates the threshold.

(<n> is irrelevant.)

Parameters:

<Threshold> Numeric value.
The unit depends on `CALCulate<n>:LIMit<k>:UNIT` on page 367.

*RST: -200 dBm

CALCulate<n>:LIMit<k>:NAME <Name>

This command selects a limit line that already exists or defines a name for a new limit line.

Parameters:

<Name> String containing the limit line name.

*RST: REM1 to REM8 for lines 1 to 8

Manual operation: See "Name" on page 151

CALCulate<n>:LIMit<k>:UNIT <Unit>

This command defines the unit of a limit line.

(<n> is irrelevant.)

Parameters:

<Unit> If you select dB as the limit line unit, the command automatically turns the limit line into a relative limit line.

*RST: DBM

Manual operation: See "Y-Axis" on page 152

CALCulate<n>:LIMit<k>:UPPer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of an upper limit line.

(<n> is irrelevant.)

Parameters:

<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<k>:CONTrol[:DATA]`. If not, the R&S FSWP either adds missing values or ignores surplus values.

*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual operation: See "Data points" on page 152

CALCulate<n>:LIMit<k>:UPPer:MARGin <Margin>

This command defines an area around an upper limit line where limit check violations are still tolerated.

(<n> is irrelevant.)

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

CALCulate<n>:LIMit<k>:UPPer:MODE <Mode>

This command selects the vertical limit line scaling.

Parameters:

<Mode>

ABSolute
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

CALCulate<n>:LIMit<k>:UPPer:SHIFt <Distance>

This command moves a complete upper limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

(<n> is irrelevant.)

Parameters:

<Distance> Defines the distance that the limit line moves.

Usage: Event

Manual operation: See "Shift y" on page 153

CALCulate<n>:LIMit<k>:UPPer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of an upper limit line from one horizontal point to the next.

Parameters:

<InterpolType> LINear | LOGarithmic

*RST: LIN

Manual operation: See "Y-Axis" on page 152

CALCulate<n>:LIMit<k>:UPPer:THReshold <Limit>

This command defines an absolute limit for limit lines with a relative scale.

The R&S FSWP uses the threshold for the limit check, if the limit line violates the threshold.

(<n> is irrelevant.)

Parameters:

<Limit>

Numeric value.
The unit depends on `CALCulate<n>:LIMit<k>:UNIT` on page 367.

*RST: -200
Default unit: dBm

Reading out the Results of a Limit Check

CALCulate<n>:LIMit<k>:CLEar[:IMMediate] 369
CALCulate<n>:LIMit<k>:FAIL? 369

CALCulate<n>:LIMit<k>:CLEar[:IMMediate]

This command deletes the result of the current limit check.

The command works on *all* limit lines in *all* measurement windows at the same time (<n>, <k> are irrelevant).

Example: `CALC:LIM:CLE`
Deletes the result of the limit check.

Usage: SCPI confirmed

CALCulate<n>:LIMit<k>:FAIL?

This command queries the result of a limit check.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Return values:
<Result> **0**
PASS
1
FAIL

Example: `INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC:LIM3:FAIL?`
Queries the result of the check for limit line 3.

Usage: Query only
SCPI confirmed

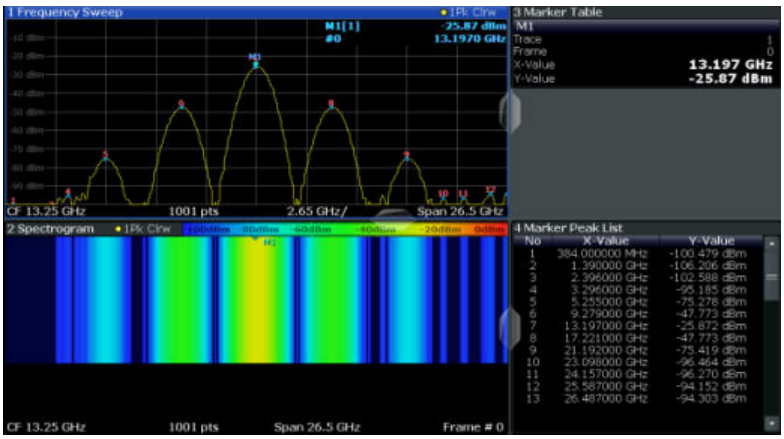
12.7.6 Examples: Configuring the Result Display

The following example demonstrates how to configure result displays in a remote environment.

12.7.6.1 Example 1: Adding and Arranging Windows

Starting from the default initial display in the Spectrum application (Frequency Sweep), we will configure the following result displays:

1 Frequency Sweep	3 Marker Table
2 Spectrogram	4 Marker Peak List

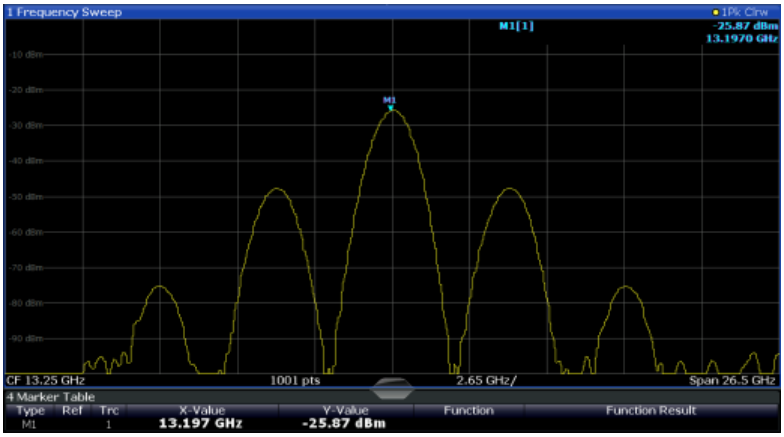



```
//--------------Resetting the instrument -----------
*RST
//--------------- Adding new windows --------------------
//Add a Spectrogram window beneath the Frequency Sweep window
LAY:ADD? '1',BEL,SGR
//Result: window number: '2'
//Add a Marker Table window to the right of the Frequency Sweep window
LAY:ADD? '1',RIGH,MTAB
//Result: window number: '3'
//Add a Marker Peak List window to the right of the Spectrogram window
LAY:WIND2:ADD? RIGH,PEAK
//Result: window number: '4'

//--------------- Changing the size of individual windows -------------
//Move the splitter between the Frequency Sweep window and the Marker Table
//window to enlarge the spectrum display to 60% of the entire width.
LAY:SPL 1,3,60
//Move the splitter between the Spectrogram window and the Marker Peak List
//window to enlarge the Spectrogram display to 60% of the entire width.
LAY:SPL 2,4,60

//--------------- Querying all displayed windows ------------------
//Query the name and number of all displayed windows
//(from top left to bottom right)
LAY:CAT?
//Result : '1',1,'2',2,'3',3,'4',4

//------------- Maximizing a Window ------------------
//Maximize the window "2 Spectrogram"
DISP:WIND2:SIZE LARG

//-------------Restore multiple window display -----------
DISP:WIND2:SIZE SMAL
```

12.7.6.2 Example 2: Replacing and Removing Windows

Starting from the display configured in Example 1: Adding and Arranging Windows, we will remove and replace result displays to obtain the following configuration:

1 Frequency Sweep
4 Marker Table




```
//-------------- Preparing the configuration from example 1 -----------
*RST
LAY:ADD? '1',BEL,SGR
LAY:ADD? '1',RIGH,MTAB
LAY:WIND2:ADD? RIGH,PEAK
LAY:CAT?
//Result : '1',1,'2',2,'3',3,'4',4
//Remove Spectrogram
LAY:WIND2:REM //Remove Marker Table window
LAY:REM '3'
//Replace Marker Peak List window by Marker Table
LAY:REPL '4',MTAB

//--------------- Querying all displayed windows ------------------
//Query the name and number of all displayed windows (from top left to bottom right)
LAY:CAT?
//Result : '1',1,'4',4

//--------------- Changing the size of individual windows -------------
//Move the splitter between the Frequency Sweep window and the Marker Table window
//to enlarge the spectrum display to 80% of the entire height.
LAY:SPL 1,4,80
```

12.8 Managing Settings and Results

The commands required to store and load instrument settings and import and export measurement results in a remote environment are described here. The tasks for manual operation are described in chapter 9, "Data Management", on page 156.

Addressing drives

The various drives can be addressed via the "mass storage instrument specifier" <msis> using the conventional Windows syntax. The internal hard disk is addressed by "C:". For details on storage locations refer to chapter 9.3.2.2, "Storage Location and File Name", on page 163.

The file names (<FileName> parameter) are given as string parameters enclosed in quotation marks. They also comply with Windows conventions. Windows file names do not distinguish between uppercase and lowercase notation.

Wildcards

The two characters "*" and "?" can be used as "wildcards". Wildcards are variables for a selection of several files. The question mark "?" replaces exactly one character, the asterisk replaces any of the remaining characters in the file name. "*.*" thus means all files in a directory.

Path names

Storage locations can be specified either as absolute (including the entire path) or relative paths (including only subfolders of the current folder). Use the `MMEM:CDIR?` query to determine the current folder.

Secure user mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MHz. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

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12.8.1 Managing Files

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FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSWP to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSWP. The R&S FSWP automatically recognizes the data it receives, regardless of the format.

For details on data formats see chapter 12.7.3.5, "Formats for Returned Values: ASCII Format and Binary Format", on page 348.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
The format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 136

MMEMory:CATalog? <Path>

This command returns the contents of a particular directory.

Query parameters:

<Path>

String containing the path and directory
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory`.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.
If you use a specific file as a parameter, the command returns the name of the file if the file is found in the specified directory, or an error if the file is not found (`"-256,"File name not found"`).

Return values:

<FileNames>

List of file and directory names, separated by commas
If no files are found, an error is displayed: `"-256,"File name not found"`

Example: `MMEM:CAT? 'C:\R_S\Instr\user\SPOOL?.PNG'`
Returns all files in C:\R_S\Instr\user whose names start with SPOOL, have 6 letters and the extension ".PNG", e.g.:
`SPOOL1.PNG,SPOOL2.PNG,SPOOL3.PNG`

Example: `MMEM:CAT? 'C:\R_S\Instr\user\SPOOL6.PNG'`
Query whether the file '`SPOOL6.PNG`' also exists in the directory;
Result:
`-256,"File name not found;:MMEMory:CATalog? 'C:\R_S\Instr\user\SPOOL6.PNG'`

Usage: Query only
SCPI confirmed

Manual operation: See "Selecting the Storage Location - Drive/ Path/ Files" on page 164

MMEMory:CATalog:LONG? <Path>

This command returns the contents of a particular directory with additional information about the files.

Query parameters:

<Path> String containing the path and directory.
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory`.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.

Return values:

<UsedDiskSpace> Byte size of all files in the directory.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> <NameFileN>,<SuffixFileN>,<SizeFileN>

Describes the individual file.

<NameFileN>
Name of the file.

<SuffixFileN>
Type of the file. Possible suffixes are: ASCii, BINary, DIRectory, STAT

<SizeFileN>
Size of the file in bytes.

Usage: Query only

MMEMory:CDIRectory <Directory>

This command changes the current directory.

Parameters:

<Directory> String containing the path to another directory.
The path may be relative or absolute.

Usage: SCPI confirmed

MMEMory:COMMent <Comment>

This command defines a comment for the stored settings.

Parameters:

<Comment> String containing the comment.

Example:
```
MMEMory:COMMent "ACP measurement with Standard Tetra from 23.05."
MMEMory::MMEMory:STORe1:STATe 1, "ACP_T"
```
As a result, in the selection list for recall settings, the comment `"ACP measurement with Standard Tetra from 23.05."` is added to the ACP entry.

Manual operation: See "Comment" on page 164

MMEMory:COPY <SourceFile>,<DestinationFile>

This command copies one or more files to another directory.

Parameters:

<SourceFile> String containing the path and file name of the source file.

<DestinationFile> String containing the path and name of the target file.
The path may be relative or absolute.

Usage: SCPI confirmed

MMEMory:DATA <FileName>, [<Block>]

This command writes block data into a file. The delimiter must be set to EOI to obtain error-free data transfer.

When you query the contents of a file, you can save them in a file on the remote control computer.

The command is useful for reading stored settings files or trace data from the instrument or for transferring them to the instrument

Parameters:

<FileName> String containing the path and name of the target file.

<Block> Data block with the following structure.
#
Hash sign.
<number>
Length of the length information.
<number>
Length information of the binary data (number of bytes).
<data>
Binary data with the indicated <number> of bytes.

Example:
```
MMEM:NAME '\Public\User\Testfile.txt'
```
Creates a new file called 'testfile.txt'.
```
MMEM:DATA 'Testfile.txt',#220Contents of the
file
```
The parameter means:
#2: hash sign and length of the length information (20 bytes = 2 digits)
20: indicates the number of subsequent binary data bytes.
Contents of the file: store 20 binary bytes (characters) to the file.

Usage: SCPI confirmed

MMEMory:DELete <FileName>

This command deletes a file.

Parameters:

<FileName> String containing the path and file name of the file to delete.
The path may be relative or absolute.

Usage: Event
SCPI confirmed

MMEMory:MDIRectory <Directory>

This command creates a new directory.

Parameters:

<Directory> String containing the path and new directory name
The path may be relative or absolute.

Usage: Event

MMEMory:MOVE <SourceFile>,<NewFileName>

This command moves a file to another directory.

The command also renames the file if you define a new name in the target directory.

If you do not include a path for <NewFileName>, the command just renames the file.

Parameters:

<SourceFile> String containing the path and file name of the source file.

<NewFileName> String containing the path and name of the target file.

Example: `MMEM:MOVE 'C:\TEST01.CFG','SETUP.CFG'`
Renames TEST01.CFG in SETUP.CFG in directory C:\.

Usage: Event
SCPI confirmed

MMEMory:MSIS <Device>

This command selects the default storage device used by all MMEMory commands.

Parameters:

<Device> 'A:' | 'C:' | … | 'Z:'
String containing the device drive name
*RST: 'C:'

Usage: SCPI confirmed

MMEMory:NAME <FileName>

This command creates a new and empty file.

It also sets the file name for screenshots taken with `HCOPy[:IMMediate<device>]`.
Note that you have to route the printer output to a file.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:NAME 'C:\R_S\instr\user\PRINT1.BMP'`
Selects the file name.

Usage: Event
SCPI confirmed

MMEMory:NETWork:DISConnect <Drive>

This command disconnects a network drive.

Parameters:

<Drive> String containing the drive name.

Usage: Event

MMEMory:NETWork:MAP <Drive>, <HostName> [, <UserName>, <Password>][, <Reconnect>]

This command maps a drive to a server or server directory of the network.

Note that you have to allow sharing for a server or folder in Microsoft networks first.

Parameters:

<Drive> String containing the drive name or path of the directory you want to map.

<HostName> String containing the host name of the computer or the IP address and the share name of the drive.
'<\host name or IP address\share name>'

<UserName> String containing a user name in the network.
The user name is optional.

<Password> String containing the password corresponding to the <User-Name>.
The password is optional.

<Reconnect> ON | OFF

ON
Reconnects at logon with the same user name.

OFF
Does not reconnect at logon.

Usage: Event

MMEMory:NETWork:UNUSeddrives?

This command returns a list of unused network drives.

Return values:

<DriveName> List of network drives in alphabetically descending order, e.g. 'W:,V:,U:,...'

Usage: Query only

MMEMory:NETWork:USEDdrives? <State>

This command returns a list of all network drives in use.

Parameters:

<State> You do not have to use the parameter. If you do not include the parameter, the command returns a list of all drives in use.
This is the same behavior as if you were using the parameter OFF.

ON
Returns a list of all drives in use including the folder information.

OFF
Returns al list of all drives in use.

Usage: Query only

MMEMory:RDIRectory <Directory>

This command deletes the indicated directory.

Parameters:

<Directory> String containing the path of the directory to delete.
Note that the directory you want to remove must be empty.

Usage: Event

12.8.2 Selecting Items to Store

The following commands select the items to be included in the configuration file.

Depending on the used command, either the items from the entire instrument (`MMEMory:SELect[:ITEM]...`), or only those from the currently selected channel (`MMEM:SELect:CHANnel[:ITEM]...`) are stored.

MMEMory:SELect:CHANnel[:ITEM]:ALL 380
MMEMory:SELect[:ITEM]:ALL 380
MMEMory:SELect:CHANnel[:ITEM]:DEFault 380
MMEMory:SELect[:ITEM]:DEFault 380
MMEMory:SELect:CHANnel[:ITEM]:HWSettings 380
MMEMory:SELect[:ITEM]:HWSettings 380
MMEMory:SELect:CHANnel[:ITEM]:LINes:ALL 381
MMEMory:SELect[:ITEM]:LINes:ALL 381
MMEMory:SELect:CHANnel[:ITEM]:NONE 381
MMEMory:SELect[:ITEM]:NONE 381
MMEMory:SELect:CHANnel[:ITEM]:SGRam 381

MMEMory:SELect[:ITEM]:SGRam 381
MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive] 382
MMEMory:SELect[:ITEM]:TRACe[:ACTive] 382
MMEMory:SELect:CHANnel[:ITEM]:TRANsducer:ALL 382
MMEMory:SELect[:ITEM]:TRANsducer:ALL 382
MMEMory:SELect:CHANnel[:ITEM]:WEIGhting 382
MMEMory:SELect[:ITEM]:WEIGhting 382

MMEMory:SELect:CHANnel[:ITEM]:ALL
MMEMory:SELect[:ITEM]:ALL

This command includes all items when storing or loading a configuration file.

The items are:

- Hardware configuration: `MMEMory:SELect[:ITEM]:HWSettings`
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL`
- Spectrogram data: `MMEMory:SELect[:ITEM]:SGRam`
- Trace data: `MMEMory:SELect[:ITEM]:TRACe[:ACTive]`

Example: `MMEM:SEL:ALL`

Usage: Event

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:DEFault
MMEMory:SELect[:ITEM]:DEFault

This command selects the current settings as the only item to store to and load from a configuration file.

Usage: Event

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:HWSettings <State>
MMEMory:SELect[:ITEM]:HWSettings <State>

This command includes or excludes measurement (hardware) settings when storing or loading a configuration file.

Measurement settings include:

- general channel configuration
- measurement hardware configuration including markers
- limit lines
  Note that a configuration may include no more than 8 limit lines. This number includes active limit lines as well as inactive limit lines that were used last. Therefore the combination of inactivate limit lines depends on the sequence of use with `MMEMory:LOAD:STATe`.
- color settings

- configuration for the hardcopy output

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `MMEM:SEL:HWS ON`

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:LINes:ALL <State>
MMEMory:SELect[:ITEM]:LINes:ALL <State>

This command includes or excludes all limit lines (active and inactive) when storing or loading a configuration file.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `MMEM:SEL:LIN:ALL ON`

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:NONE
MMEMory:SELect[:ITEM]:NONE

This command does not include any of the following items when storing or loading a configuration file.

- Hardware configuration: `MMEMory:SELect[:ITEM]:HWSettings`
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL`
- Spectrogram data: `MMEMory:SELect[:ITEM]:SGRam`
- Trace data: `MMEMory:SELect[:ITEM]:TRACe[:ACTive]`

Example: `MMEM:SEL:NONE`

Usage: Event

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:SGRam <State>
MMEMory:SELect[:ITEM]:SGRam <State>

This command includes or excludes spectrogram data when storing or loading a configuration file.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `MMEM:SEL:SGR ON`
Adds the spectrogram data to the list of data subsets.

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive] <State>
MMEMory:SELect[:ITEM]:TRACe[:ACTive] <State>

This command includes or excludes trace data when storing or loading a configuration file.

Parameters:
<State> ON | OFF
*RST: OFF, i.e. no traces is stored

Example: `MMEM:SEL:TRAC ON`

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:TRANsducer:ALL <State>
MMEMory:SELect[:ITEM]:TRANsducer:ALL <State>

This command includes or excludes transducer factors when storing or loading a configuration file.

The command is available in the optional Spectrum application.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `MMEM:SEL:TRAN:ALL ON`

Manual operation: See "Items" on page 165

MMEMory:SELect:CHANnel[:ITEM]:WEIGhting <State>
MMEMory:SELect[:ITEM]:WEIGhting <State>

This command includes or excludes weighting filter for residual effects when storing or loading a configuration file.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `MMEM:SEL:WEIG ON`

12.8.3 Saving and Loading Instrument Settings

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MMEMory:CLEar:STATe....383
MMEMory:LOAD:AUTO....383
MMEMory:LOAD:STATe....383
MMEMory:STORe<n>:STATe....384
MMEMory:STORe<n>:STATe:NEXT....385

MMEMory:STORe<n>:TYPE....386
SYSTem:PRESet....386
SYSTem:PRESet:CHANnel[:EXECute]....386

MMEMory:CLEar:ALL

This command deletes all instrument configuration files in the current directory.

You can select the directory with `MMEMory:CDIRectory`.

Example: `MMEM:CLE:ALL`

Usage: Event

MMEMory:CLEar:STATe 1,<FileName>

This command deletes a instrument configuration file.

Parameters:
1

<FileName> String containing the path and name of the file to delete.
The string may or may not contain the file's extension.

Example: `MMEM:CLE:STAT 1,'TEST'`

Usage: Event

MMEMory:LOAD:AUTO 1, 'Factory' | <FileName>

This command restores an instrument configuration and defines that configuration as the default state.

The default state is restored after a preset (`*RST`) or after you turn on the R&S FSWP.

Parameters:
1

'Factory' | <FileName>
'Factory'
Restores the factory settings as the default state.

'<file_name>
String containing the path and name of the configuration file.
Note that only *instrument* settings files can be selected for the startup recall function; channel settings files cause an error.

Example: `MMEM:LOAD:AUTO 1,'C:\R_S\Instr\user\TEST'`

Usage: Event

Manual operation: See "Startup Recall" on page 166

MMEMory:LOAD:STATe 1, <FileName>

This command restores and activates the instrument configuration stored in a *.dfl file.

Note that files with other formats cannot be loaded with this command.

The contents that are reloaded from the file are defined by the last selection made either in the "Save/Recall" dialogs (manual operation) or through the `MMEMory:SELect[:ITEM]` commands (remote operation; the settings are identical in both cases).

By default, the selection is limited to the user settings ("User Settings" selection in the dialogs, `HWSettings` in SCPI). The selection is not reset by PRESET or `*RST`.

As a consequence, the results of a SCPI script using the `MMEMory:LOAD:STATe` command without a previous `MMEMory:SELect[:ITEM]` command may vary, depending on previous actions in the GUI or in previous scripts, even if the script starts with the `*RST` command.

It is therefore recommended that you use the appropriate `MMEMory:SELect[:ITEM]` command before using `MMEMory:LOAD:STATe`.

Parameters:
1

<FileName> String containing the path and name of the file to load.
The string may or may not include the file's extension.

Example:
```
MMEM:SEL:ALL
```
//Save all items (User Settings, All Traces, All Limit Lines) from the R&S FSWP.
```
MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST01'
```
//Reloads all items
In the "Recall" dialog, select only "User Settings" and "All Limit Lines".
```
MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST01'
```
//Reloads user settings and all limit lines.
```
*RST
```
//Reset instrument.
```
MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST01'
```
//Selected items are retained. Reloads user settings and all limit lines.
Restart the instrument.
(Switch the ON/OFF key off and on).
```
MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST01'
```
// Selected items are set to default. Reloads only the user settings.

Usage: SCPI confirmed

Manual operation: See "Recall" on page 162
See "Recall in New Channel / Recall in Current Channel" on page 165

MMEMory:STORe<n>:STATe 1,<FileName>

This command saves the current instrument configuration in a *.dfl file.

The suffix <n> is irrelevant.

Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Parameters:
1

<FileName> String containing the path and name of the target file.
The file extension is .dfl.

Example: `MMEM:STOR:STAT 1,'Save'`
Saves the current instrument settings in the file `Save.dfl`.

Usage: Event
SCPI confirmed

Manual operation: See "Save File" on page 165

MMEMory:STORe<n>:STATe:NEXT

This command saves the current instrument configuration in a *.dfl file.

The suffix <n> is irrelevant.

The file name depends on the one you have set with `MMEMory:STORe<n>:STATe`. This command adds a consecutive number to the file name.

Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Example: `MMEM:STOR:STAT 1,'Save'`
Saves the current instrument settings in the file `Save.dfl`.
`MMEM:STOR:STAT:NEXT`
Saves the current instrument settings in the file `Save_001.dfl`
`MMEM:STOR:STAT:NEXT`
Saves the current instrument settings in the file `Save_002.dfl`

Usage: Event

Manual operation: See "Save File" on page 165

MMEMory:STORe<n>:TYPE <Mode>

This command defines whether the data from the entire instrument or only from the current channel is stored with the subsequent `MMEM:STOR...` command.

The suffix <n> is irrelevant.

Parameters:

<Mode> INSTrument | CHANnel

INSTrument
Stores data from the entire instrument.

CHANnel
Stores data from an individual channel.

*RST: INST

Example: `INST:SEL 'SPECTRUM2'`
Selects measurement channel `'SPECTRUM2'`.
`MMEM:STOR:TYPE CHAN`
Specifies that channel-specific data is to be stored.

SYSTem:PRESet

This command presets the R&S FSWP.

Example: `SYST:PRES`

Usage: Event
SCPI confirmed

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 96

12.8.4 Storing and Printing Screenshots

Useful commands to perform measurements described elsewhere:

- `MMEMory:NAME` on page 377

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DISPlay:LOGO <State>

Activates/deactivates the printout of the Rohde & Schwarz company logo in the upper left corner.

Parameters:

<State> ON | OFF

*RST: ON

Example: `DISP:LOGO OFF`

Manual operation: See "Print Logo" on page 177

HCOPy:ABORt

This command aborts a running hardcopy output.

Example: `HCOP:ABOR`

Usage: Event
SCPI confirmed

HCOPy:CMAP<item>:DEFault<colors>

This command defines the color scheme for print jobs.

Suffix:

<item> Selects the item for which the color scheme is to be defined. For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

<colors> 1...4
1
Current colors with a white background and a black grid.
2
Optimized colors.
3
Customized colors.
4
Current screen colors (setting for hardcopies).

Example: `HCOP:CMAP:DEF2`
Selects the optimized color set for the color settings of a printout or a hardcopy.

Usage: Event

Manual operation: See "Print colors" on page 204

HCOPy:CMAP<item>:HSL <Color>

This command selects the color for various screen elements in print jobs.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

Parameters:
<Color>
hue
tint
sat
saturation
lum
brightness
The value range is 0 to 1 for all parameters.

Example: `HCOP:CMAP2:HSL 0.3,0.8,1.0`
Changes the grid color

Manual operation: See "Defining User-specific Colors" on page 205

HCOPy:CMAP<item>:PDEFined <Color>

This command selects a predefined color for various screen elements in print jobs.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

Parameters:

<Color> BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

Example: `HCOP:CMAP2:PDEF GRE`

Manual operation: See "Predefined Colors" on page 205

HCOPy:DESTination<device> <Destination>

This command selects the destination of a print job.

Suffix:

<device> 1 | 2
Printing device.

Parameters:

<Destination> **'MMEM'**
Sends the hardcopy to a file.
You can select the file name with `MMEMory:NAME`.
You can select the file format with `HCOPy:DEVice:LANGuage<device>`.

'SYST:COMM:PRIN'
Sends the hardcopy to a printer.
You can select the printer with `SYSTem:COMMunicate:PRINter:SELect<device>`.

'SYST:COMM:CLIP'
Sends the hardcopy to the clipboard.
The format should be WEMF.

*RST: 'SYST:COMM:CLIP'

Usage: SCPI confirmed

Manual operation: See "Device" on page 178

HCOPy:DEVice:COLor <State>

This command turns color printing on and off.

Parameters:

<State> **ON**
Color printing

OFF
Black and white printing

*RST: OFF

Example: `HCOP:DEV:COL ON`

Usage: SCPI confirmed

HCOPy:DEVice:LANGuage<device> <Format>

This command selects the file format for a print job.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<Format> **GDI**
Graphics Device Interface.
Default format for the output to a printer configured under Windows. Must be selected for the output to the printer interface. Can be used for the output to a file. The printer driver configured under Windows is used in this case and a printer-specific file format is thus generated.

BMP, JPG, PNG
Data format for output to files only.

Usage: SCPI confirmed

Manual operation: See "Output Medium" on page 177

HCOPy[:IMMediate<device>]

This command initiates a print job.

If you are printing to a file, the file name depends on `MMEMory:NAME`.

Suffix:
<device> 1 | 2
Printing device.

Usage: Event
SCPI confirmed

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 176

HCOPy[:IMMediate<device>]:NEXT

This command initiates a print job.

If you are printing to a file, the file name depends on `MMEMory:NAME`. This command adds a consecutive number to the file name.

Suffix:
<device> 1 | 2
Printing device.

Usage: Event

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 176

HCOPy:ITEM:ALL

This command includes all screen elements in the printout.

The screen elements include comments, title, time and date.

Usage: SCPI confirmed

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 176

HCOPy:ITEM:WINDow:TEXT <Comment>

This command defines a comment to be added to the printout.

Parameters:
<Comment> String containing the comment.

Usage: SCPI confirmed

Manual operation: See "Comment" on page 178

HCOPy:PAGE:ORIentation<device> <Orientation>

The command selects the format of the print job.

The command is only available if the output device is a printer.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<Orientation> LANDscape | PORTrait
*RST: PORTrait

Usage: SCPI confirmed

Manual operation: See "Orientation" on page 178

HCOPy:TDSTamp:STATe<device> <State>

This command includes or excludes the time and date in the printout.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Print Date and Time" on page 177

SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?

This command queries the name of the first available printer.

To query the name of other installed printers, use `SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?`.

Return values:

<PrinterName> String containing the name of the first printer as defined in Windows.
If the command cannot find a printer, it returns an empty string (' ').

Usage: Query only

Manual operation: See "Printer Name" on page 178

SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?

This command queries the name of available printers.

You have to use `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` for this command to work properly.

Return values:

<PrinterName> String containing the name of one printer as defined in Windows. To get a complete list of printers you have to send this query several times until no more printers could be found. In that case, the return value is an empty string (' '). Further queries after the empty string result in an error.

Usage: Query only

Manual operation: See "Printer Name" on page 178

SYSTem:COMMunicate:PRINter:SELect<device> <PrinterName>

This command selects the printer that processes jobs sent by the R&S FSWP.

Use `HCOPy:DESTination<device>` to select another output destination.

Suffix:

<device> 1 | 2
Printing device.

Parameters:

<PrinterName> String containing the printer name.
Use
- `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` and
- `SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?`

to query all available printers.

*RST: NONE

Manual operation: See "Printer Name" on page 178

12.8.5 Saving Measurement Results

Useful commands to store measurement results described elsewhere:

- `FORMat[:DATA]` on page 345

MMEMory:STORe<n>:TRACe....393

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

For details on the file format see chapter 9.4.3, "Reference: ASCII File Export Format", on page 171.

Secure User Mode

In secure user mode, settings that are to be stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "Memory full" error may occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Parameters:

<Trace>	Number of the trace to be stored
<FileName>	String containing the path and name of the target file.
Example:	`MMEM:STOR1:TRAC 3,'C:\TEST.ASC'` Stores trace 3 from window 1 in the file `TEST.ASC`.
Usage:	SCPI confirmed
Manual operation:	See "Export Trace to ASCII File" on page 136

12.8.6 Examples: Managing Data

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12.8.6.1 Storing Data

```
MMEM:MSIS 'C:'
//Selects drive C: as the default storage device.
-----Connecting a network drive--------
MMEM:NETW:USED?
//Returns a list of all drives in use in the network.
```

```
MMEM:NETW:UNUS?
//Returns a list of free drive names in the network.
MMEM:NETW:MAP 'T:','Server\ACLRTest'
//Maps drive T: to the directory 'Server\ACLRTest'
-----Saving data on the instrument-----
MMEM:MDIR 'C:\R_S\INST\USER\ACLRTest'
//Creates a directory called 'ACLRTest' on drive C:
MMEM:NAME 'C:\R_S\INST\USER\Test001.txt'
//Creates a file called 'Test001.txt'
MMEM:COMM 'ACLR test results'
//Creates a comment for the file.
MMEM:DATA 'Test001.txt',#212FileContents
//Writes 12 characters to the file 'Test001.txt'
-----Copying the data to another location---
MMEM:COPY 'C:\R_S\INST\USER\Results\Test001.txt','T:'
//Copies the specified file to network drive T:.
MMEM:DEL 'C:\R_S\INST\USER\Results\Test001.txt'
//Deletes the specified file from the instrument hard disk.
//or
MMEM:MOVE 'C:\R_S\INST\USER\Results\Test001.xml','D:\TestResults.txt'//
//Moves the file 'Test001.txt' to drive T:, renames it to 'Testresults.txt'
//and removes it from the instrument hard disk.
MMEM:RDIR 'C:\R_S\INST\USER\Results'
//Deletes the directory called 'Results' from drive C:, unless it still contains any content.
-----Disconnecting the network drive---
MMEM:NETW:DISC 'T:'
//Disconnect drive T:.
```

12.8.6.2 Loading Data

```
MMEM:CDIR?
//Returns the path of the current directory.
//e.g.
C:\R_S\Instr\user\
MMEM:CDIR 'C:\R_S\INST\USER\Results'
//Changes the current directory.
MMEM:CAT? 'C:\R_S\INST\USER\Results\*.xml'
//or
MMEM:CAT? '*.xml'
//Returns a list of all xml files in the directory 'C:\R_S\INST\USER\Results'.
MMEM:CAT:LONG? '*.xml'
//Returns additional information about the xml files in the directory 'C:\R_S\INST\USER\Result
```

12.8.6.3 Storing Instrument Settings

In this example we will store the instrument settings for the "Spectrum" channel.

```
INST:SEL 'SPECTRUM'
//Selects measurement channel 'SPECTRUM'.
```

```
MEMM:STOR:TYPE CHAN
//Specifies that channel-specific data is to be stored.
MMEM:STOR:STAT 1, 'C:\R_S\Instr\user\Spectrum'
//Stores the channel settings from the 'Spectrum' channel
// to the file 'Spectrum.dfl'.
```

12.8.6.4 Loading Instrument Settings

In this example we will load the hardware settings from the configuration file `Spectrum.dfl` to a new "Spectrum2" channel.

```
MEMM:LOAD:TYPE NEW
//Specifies that settings will be loaded to a new channel besides the existing
//'Spectrum' channel.
MMEM:SEL:CHAN:HWS ON
//Selects only hardware settings to be loaded.
MMEM:LOAD:STAT 1, 'C:\R_S\Instr\user\Spectrum'
//Loads the channel-specific settings from the file 'C:\R_S\Instr\user\Spectrum.dfl'
//to a new channel. The new channel is named 'Spectrum2' to avoid a naming conflict
//with the existing 'Spectrum' channel.
INST:REN 'Spectrum2','Spectrum3'
//Renames the loaded channel to 'Spectrum3'.
```

12.8.6.5 Printing to a File

```
HCOP:DEST 'MMEM'
//Prints the data to a file.
HCOP:DEV:LANG BMP
//Selects bmp as the file format.
MMEM:NAME 'C:\R_S\INST\USER\Screenshot.bmp'
//Selects the file name for the printout.
HCOP:ITEM:ALL
//Prints all screen elements
HCOP:ITEM:WIND:TEXT 'ACLRResults'
//Adds a comment to the printout.
HCOP
//Stores the printout in a file called 'Screenshot.bmp'.
HCOP:NEXT
//Stores the printout in a file called 'Screenshot_001.bmp'.
```

12.8.6.6 Printing on a Printer

```
HCOP:DEST2 'SYST:COMM:PRIN'
//Prints the data on a printer.
SYST:COMM:PRIN:ENUM:FIRS?
SYST:COMM:PRIN:ENUM?
//Returns the available printers, e.g.
'LASER on LPT1'
''
```

```
//Means that one printer is available.
SYST:COMM:PRIN:SEL2 'LASER on LPT1'
//Selects the printer for the print job on device 2.
HCOP:PAGE:ORI2 LAND
//Selects the landscape format for the printout.
HCOP:TDST:STAT2 ON
//Includes date and time on the printout.
HCOP:ITEM:ALL
//Prints all screen elements
HCOP
//Initiates the printout.
```

12.9 Configuring the R&S FSWP

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12.9.1 Basic Instrument Setup

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SYSTem:CLOGging <State>

This command turns logging of remote commands on and off.

Parameters:

<State>

ON
Writes all remote commands that have been sent to a file. The destination is `C:\R_S\instr\ScpiLogging\ScpiLog.txt`.

OFF

*RST: OFF

Manual operation: See "I/O Logging" on page 254

SYSTem:REBoot

This command reboots the instrument, including the operating system.

Usage: Event

SYSTem:SHUTdown

This command shuts down the R&S FSWP.

Usage: Event

12.9.2 Configuring the Reference Frequency

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[SENSe:]ROSCillator:TRANge....400

[SENSe:]ROSCillator:LBWidth <Bandwidth>

Defines the loop bandwidth, that is, the speed of internal synchronization with the reference frequency. The setting requires a compromise between performance and increasing phase noise.

For a variable external reference frequency with a narrow tuning range (+/- 0.5 ppm), the loop bandwidth is fixed to 0.1 Hz and cannot be changed.

Parameters:

<Bandwidth> 0.1 Hz | 1 Hz | 3 Hz | 10 Hz | 30 Hz | 100 Hz | 300 Hz

The possible values depend on the reference source and tuning range (see table 10-1).

Default unit: Hz

Example: `ROSC:LBW 3`

Manual operation: See "Loop Bandwidth" on page 184

[SENSe:]ROSCillator:O100 <State>

If enabled, a 100 MHz reference signal is provided to the REF OUTPUT 100 MHZ connector.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ROSC:O100 ON`

Manual operation: See "Reference Frequency Output" on page 184

[SENSe:]ROSCillator:O640 <State>

If enabled, a 640 MHz reference signal is provided to the REF OUTPUT 640 MHZ connector.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ROSC:O640 ON`

Manual operation: See "Reference Frequency Output" on page 184

SOURce:EXTernal:ROSCillator:EXTernal:FREQuency <Frequency>

This command defines the frequency of the external reference oscillator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameters:

<Frequency> Range: 1 MHz to 20 MHz

Example: `ROSC:EXT:FREQ 13MHZ`
Sets the frequency to 13 MHz.
`SOUR:EXT:ROSC:EXT:FREQ 13MHZ`

Manual operation: See "Reference Frequency Input" on page 182

[SENSe:]ROSCillator:OSYNc <State>

If enabled, a 100 MHz reference signal is provided to the SYNC TRIGGER OUTPUT connector.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ROSC:OSYN ON`

Manual operation: See "Reference Frequency Output" on page 184

[SENSe:]ROSCillator:SOURce <Source>

This command selects the reference oscillator.

If you want to select the external reference, it must be connected to the R&S FSWP.

Parameters:

<Source>

INTernal
the internal reference is used (10 MHz)

EXTernal
the external reference from REF INPUT 1..20 MHZ connector is used with a variable frequency; if none is available, an error flag is displayed in the status bar

E10
the external reference from REF INPUT 1..20 MHZ connector is used with a fixed 10 MHZ frequency; if none is available, an error flag is displayed in the status bar

E100
the external reference from REF INPUT 100 MHZ connector is used; if none is available, an error flag is displayed in the status bar

EAUTo
the external reference is used as long as it is available, then the instrument switches to the internal reference

SYNC
the external reference is used; if none is available, an error flag is displayed in the status bar

Example: `ROSC:SOUR EXT`

Usage: SCPI confirmed

Manual operation: See "Reference Frequency Input" on page 182
See "Behavior in case of missing external reference" on page 183

[SENSe:]ROSCillator:SOURce:EAUTo?

This command queries the current reference type in case you have activated an automatic switch to the internal reference if the external reference is missing.

Parameters:

<Reference>

INT
internal reference

EXT
external reference

Example: `SENS:ROSC:SOUR:EAUT?`
Queries the currently available reference type.

Usage: Query only

Manual operation: See "Behavior in case of missing external reference" on page 183

[SENSe:]ROSCillator:TRANge <Range>

Defines the tuning range. The tuning range is only available for the variable external reference frequency. It determines how far the frequency may deviate from the defined level in parts per million (10^{-6}).

Parameters:

<Range> The possible values depend on the reference source (see table 10-1).

SMALl
With this smaller deviation (+/- 0.5 ppm) a very narrow fixed loop bandwidth of 0.1 Hz is realized. With this setting the instrument can synchronize to an external reference signal with a very precise frequency. Due to the very narrow loop bandwidth, unwanted noise or spurious components on the external reference input signal are strongly attenuated. Furthermore, the loop requires about 30 seconds to reach a locked state. During this locking process, "NO REF" is displayed in the status bar.

WIDE
The larger deviation (+/- 6 ppm) allows the instrument to synchronize to less precise external reference input signals.

Example: `ROSC:TRAN WIDE`

Manual operation: See "Tuning Range" on page 184

12.9.3 Calibrating the R&S FSWP and Checking Temperature

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DIAGnostic:SERVice:INPut:RF:SPECtrum....402
DIAGnostic:SERVice:INPut[:SELect]....402
DIAGnostic:SERVice:INPut:SYNThtwo[:FREQuency]....403
DIAGnostic:SERVice:STESt:RESult?....403
SOURce:TEMPerature:FRONtend?....403

CALibration[:ALL]?

This command initiates a calibration (self-alignment) routine and queries if calibration was successful.

During the acquisition of correction data the instrument does not accept any remote control commands.

Note: If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed.

In order to recognize when the acquisition of correction data is completed, the MAV bit in the status byte can be used. If the associated bit is set in the Service Request Enable (SRE) register, the instrument generates a service request after the acquisition of correction data has been completed.

Return values:

<CalibrationState> **0**
The command returns a '0' if calibration was successful.

Example: `*CLS`
Resets the status management.
`*SRE 16`
Enables MAV bit in the Service Request Enable register.
`*CAL?`
Starts the correction data recording, and then a service request is generated.

Usage: Query only
SCPI confirmed

Manual operation: See "Starting a Self-alignment" on page 185

CALibration:RESult?

This command returns the results collected during calibration.

Return values:

<CalibrationData> String containing the calibration data.

Example: `CAL:RES?`
would return, e.g.

```
Total Calibration Status:
PASSED, Date (dd/mm/yyyy): 12/07/2004,
Time: 16:24:54,Runtime: 00.06
```

Usage: Query only

Manual operation: See "Alignment Results" on page 186

DIAGnostic:SERVice:INPut:MC:DISTance <Bandwidth>

This command selects the distance of the peaks of the microwave calibration signal for calibration of the YIG filter.

Parameters:

<Bandwidth> **SMALl**
Small offset of combline frequencies.

WIDE
Wide offset of combline frequencies.

Manual operation: See "Calibration Frequency MW" on page 195

DIAGnostic:SERVice:INPut:PULSed:CFRequency <Frequency>

This command defines the frequency of the calibration signal.

Before you can use the command, you have to feed in a calibration signal with `DIAGnostic:SERVice:INPut[:SELect]`.

Parameters:

<Frequency> Possible frequencies of the calibration signal are fix.
If you define a frequency that is not available, the R&S FSWP uses the next available frequency. Example: a frequency of 20 MHz is rounded up to the next available frequency (21.33 MHz).

*RST: 64 MHz
Default unit: Hz

Manual operation: See "Calibration Frequency RF" on page 195

DIAGnostic:SERVice:INPut:RF:SPECtrum <Bandwidth>

This command selects the bandwidth of the calibration signal.

Parameters:

<Bandwidth>

NARRowband
Narrowband signal for power calibration of the frontend.

BROadband
Broadband signal for calibration of the IF filter.

Manual operation: See "Spectrum" on page 195

DIAGnostic:SERVice:INPut[:SELect] <Signal>

This command activates or deactivates the use of an internal calibration signal as input for the R&S FSWP.

Parameters:

<Signal>

CALibration
Uses the calibration signal as RF input.

MCALibration
Uses the calibration signal for the microwave range as RF input.

RF
Uses the signal from the RF input.

SYNTtwo
Uses the calibration signal to check the phase noise of the two synthesizers. A second synthesizer is available as an hardware option.

*RST: RF

Example: `DIAG:SERV:INP CAL`
Uses the calibration signal as RF input.

Manual operation: See "None" on page 195
See "Calibration Frequency RF" on page 195
See "Calibration Frequency MW" on page 195
See "Calibration Synthesizer 2" on page 196

DIAGnostic:SERVice:INPut:SYNThtwo[:FREQuency] <Frequency>

This command selects the frequency which the synthesizers are calibrated for.

The command is available when you select the synthesizer as the calibration source with `DIAGnostic:SERVice:INPut[:SELect]` on page 402.

Parameters:
<Frequency> <numeric value>
Default unit: Hz

Example:
```
DIAG:SERV:INP:SEL SYNT
DIAG:SERV:INP:SYNT 10MHZ
```

Manual operation: See "Calibration Synthesizer 2" on page 196

DIAGnostic:SERVice:STESt:RESult?

This command queries the self-test results.

Return values:
<Results> String of data containing the results.
The rows of the self-test result table are separated by commas.

Example:
```
DIAG:SERV:STES:RES?
```
would return, e.g.
```
"Total Selftest Status:
PASSED", "Date (dd/mm/yyyy): 09/07/2004 TIME:
16:24:54", "Runtime: 00:06", "...
```

Usage: Query only

SOURce:TEMPerature:FRONtend?

This command queries the current frontend temperature of the R&S FSWP.

During self-alignment, the instrument's (frontend) temperature is also measured (as soon as the instrument has warmed up completely). This temperature is used as a reference for a continuous temperature check during operation. If the current temperature deviates from the stored self-alignment temperature by a certain degree, a warning is displayed in the status bar indicating the resulting deviation in the measured power levels. A status bit in the `STATUs:QUEStionable:TEMPerature` register indicates a possible deviation.

(This feature is available in the optional Spectrum and Signal Analyzer application.)

Return values:
<Temperature> Temperature in degrees Celsius.

Example: SOUR:TEMP:FRON?
Queries the temperature of the frontend sensor.

Usage: Query only

12.9.4 Customizing the Screen Layout

- Configuring Screen Elements 404
- Selecting Colors and Schemes 407
- CMAP Suffix Assignment 409

12.9.4.1 Configuring Screen Elements

Useful commands to configure screen elements described elsewhere:

- DISPlay:MTABle on page 353
- DISPlay:FORMat on page 332

DISPlay:ANNotation:CBAR 404
DISPlay:ANNotation:FREQuency 404
DISPlay:SBAR[:STATe] 405
DISPlay:SKEYs[:STATe] 405
DISPlay:TBAR[:STATe] 405
DISPlay:TOUChscreen:STATe 405
DISPlay[:WINDow]:TIME 406
DISPlay[:WINDow]:TIME:FORMat 406
SYSTem:DISPlay:FPANel[:STATe] 406

DISPlay:ANNotation:CBAR <State>

This command hides or displays the channel bar information.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: DISP:ANN:CBAR OFF

Usage: SCPI confirmed

Manual operation: See "Channel Bar" on page 201

DISPlay:ANNotation:FREQuency <State>

This command turns the label of the x-axis on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: DISP:ANN:FREQ OFF

Usage: SCPI confirmed

Manual operation: See "Diagram Footer (Annotation)" on page 201

DISPlay:SBAR[:STATe] <State>

This command turns the status bar on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:SBAR:OFF`

Manual operation: See "Status Bar" on page 201

DISPlay:SKEYs[:STATe] <State>

This command turns the softkey bar on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:SKEY:OFF`

Manual operation: See "Softkey Bar" on page 201

DISPlay:TBAR[:STATe] <State>

This command turns the toolbar on or off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `DISP:TOOL ON`

Manual operation: See "Toolbar" on page 201

DISPlay:TOUChscreen:STATe <State>

This command controls the touch screen functionality.

Parameters:

<State>

ON | 1
Touch screen is active for entire screen

OFF | 0
Touch screen is inactivate for entire screen

FRAMe
Touch screen is inactivate for the diagram area of the screen, but active for softkeys, toolbars and menus.

*RST: 1

Example: `DISP:TOUC:STAT ON`

Manual operation: See "Deactivating and Activating the Touchscreen" on page 199

DISPlay[:WINDow]:TIME <State>

This command adds or removes the date and time from the display.

Parameters:

<State>

ON | OFF

*RST: OFF

Example: `DISP:TIME ON`

Manual operation: See "Date and Time" on page 201

DISPlay[:WINDow]:TIME:FORMat <Format>

This command selects the time and date format.

Parameters:

<Format>

DE
dd.mm.yyyy hh:mm:ss
24 hour format.

US
mm/dd/yyyy hh:mm:ss
12 hour format.

*RST: DE

Example: `DISP:TIME ON`
Switches the screen display of date and time on.
`DISP:TIME:FORM US`
Switches the date and time format to US.

Manual operation: See "Date and Time Format" on page 200

SYSTem:DISPlay:FPANel[:STATe] <State>

This command includes or excludes the front panel keys when working with the remote desktop.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Manual operation: See "Front Panel" on page 202
See "Mini Front Panel" on page 202

12.9.4.2 Selecting Colors and Schemes

Useful commands to select colors and schemes described elsewhere:

- `HCOPy:CMAP<item>:DEFault<colors>` on page 387
- `HCOPy:CMAP<item>:HSL` on page 388
- `HCOPy:CMAP<item>:PDEFined` on page 388

DISPlay:CMAP<item>:DEFault<colors> 407
DISPlay:CMAP<item>:HSL 407
DISPlay:CMAP<item>:PDEFined 408
DISPlay:THEMe:CATalog? 408
DISPlay:THEMe:SELect 408

DISPlay:CMAP<item>:DEFault<colors>

This command resets the color scheme for the display.

Suffix:
<item> Selects the item for which the color scheme is to be defined. For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

<colors> 1...4
1
Current colors with a white background and a black grid.
2
Optimized colors.
3
Customized colors.
4
Current screen colors (setting for hardcopies).

Example: `DISP:CMAP:DEF2`
Selects default setting 2 for setting the colors.

Usage: Event
SCPI confirmed

Manual operation: See "Screen colors" on page 204

DISPlay:CMAP<item>:HSL <Color>

This command selects the color for various screen elements in the display.

Suffix:
<item> Selects the item for which the color scheme is to be defined. For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

Parameters:
<Color>
hue
tint
sat
saturation
lum
brightness
The value range is 0 to 1 for all parameters.

Example: `DISP:CMAP2:HSL 0.3,0.8,1.0`
Changes the grid color.

DISPlay:CMAP<item>:PDEFined <Color>

This command selects a predefined color for various screen elements.

Suffix:
<item> Selects the item for which the color scheme is to be defined. For more information see chapter 12.9.4.3, "CMAP Suffix Assignment", on page 409.

Parameters:
<Color> BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

Example: `DISP:CMAP2:PDEF GRE`

Manual operation: See "Restoring the User Settings to Default Colors" on page 206

DISPlay:THEMe:CATalog?

This command queries all available display themes.

Parameters:
<Themes> String containing all available display themes.

Example: `DISP:THEMe:CAT?`

Usage: Query only

DISPlay:THEMe:SELect <Theme>

This command selects the display theme.

Parameters:

<Theme> String containing the name of the theme.

*RST: SPL

Example: `DISP:THEM:SEL "OceanBlue"`

Manual operation: See "Theme" on page 204

12.9.4.3 CMAP Suffix Assignment

Several commands to change the color settings of individual items of the display or printout are available. Which item is to be configured is defined using a <CMAP> suffix. The following assignment applies:

Suffix	Description
CMAP1	Background
CMAP2	Grid
CMAP3 *)	Common Text
CMAP4 *)	Check Status OK
CMAP5 *)	Check Status Error
CMAP6 *)	Text Special 1
CMAP7 *)	Text Special 2
CMAP8	Trace 1
CMAP9	Trace 2
CMAP10	Trace 3
CMAP11	Marker Info Text
CMAP12	Limit Lines
CMAP13	Limit and Margin Check – "Pass"
CMAP14	Limit and Margin Check – "Fail"
CMAP15 *)	Softkey Text
CMAP16 *)	Softkey Background
CMAP17 *)	Selected Field Text
CMAP18 *)	Selected Field Background
CMAP19 *)	Softkey 3D Bright Part
CMAP20 *)	Softkey 3D Dark Part
CMAP21 *)	Softkey State "On"
CMAP22 *)	Softkey State "Dialog open"
CMAP23 *)	Softkey Text Disabled
CMAP24	Logo

Suffix	Description
CMAP25	Trace 4
CMAP26	Grid – Minorlines
CMAP27	Marker
CMAP28	Display Lines
CMAP29 *)	Sweepcount – Text
CMAP30	Limit and Margin Check – Text
CMAP31	Limit and Margin Check – \"Margin\"
CMAP32 *)	Table Overall – Title Text
CMAP33 *)	Table Overall – Title Background
CMAP34 *)	Table Overall – Text
CMAP35 *)	Table Overall – Background
CMAP36 *)	Table Value – Title Text
CMAP37 *)	Table Value – Title Background
CMAP38 *)	Table Value – Text
CMAP39 *)	Table Value – Background
CMAP40	Trace 5
CMAP41	Trace 6
*) these settings can only be defined via the theme (`DISPlay:THEMe:SELect`) and are thus ignored in the SCPI command	

12.9.5 Configuring Network and Remote Control

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess....410
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator....411
SYSTem:DISPlay:UPDate....411
SYSTem:ERRor:CLEar:REM....411
SYSTem:ERRor:DISPlay....412
SYSTem:IDENtify:FACTory....412
SYSTem:IDENtify[:STRing]....412
SYSTem:LXI:INFo?....412
SYSTem:LXI:LANReset....413
SYSTem:LXI:MDEScription....413
SYSTem:LXI:PASSword....413

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

This command sets the GPIB address of the R&S FSWP.

Parameters:

<Address> Range: 0 to 30
*RST: (no influence on this parameter, factory default 20)

Example: `SYST:COMM:GPIB:ADDR 18`

Usage: SCPI confirmed

Manual operation: See "GPIB Address" on page 253

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator <Terminator>

This command selects the GPIB receive terminator.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Parameters:

<Terminator> LFEOI | EOI

LFEOI
According to the standard, the terminator in ASCII is <LF> and/or <EOI>.

EOI
For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by using only the receive terminator `EOI`.

*RST: LFEOI

Example: `SYST:COMM:GPIB:RTER EOI`

Manual operation: See "GPIB Terminator" on page 254

SYSTem:DISPlay:UPDate <State>

This command turns the display during remote operation on and off.

If on, the R&S FSWP updates the diagrams, traces and display fields only.

The best performance is obtained if the display is off during remote control operation.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SYST:DISP:UPD ON`

Manual operation: See "Remote Display Update" on page 254

SYSTem:ERRor:CLEar:REM

This command deletes all contents of the "Remote Errors" table.

Note: The remote error list is automatically cleared when the R&S FSWP is shut down.

Example: `SYST:ERR:CLE:REM`

Usage: Event

Manual operation: See "Display Remote Errors" on page 254
See "Clear Error List" on page 257

SYSTem:ERRor:DISPlay <State>

This command the error display during remote operation on and off.

If activated, the R&S FSWP displays a message box at the bottom of the screen that contains the most recent type of error and the command that caused the error.

Parameters:

<State> ON | OFF | 1 | 0
*RST: 0

Example: `SYST:ERR:DISP ON`

Manual operation: See "Display Remote Errors" on page 254

SYSTem:IDENtify:FACTory

This command resets the query to `*IDN?` to its default value.

Usage: Event

Manual operation: See "Reset to Factory String" on page 253

SYSTem:IDENtify[:STRing] <String>

This command defines the response to `*IDN?`.

Parameters:

<String> String containing the description of the instrument.

Manual operation: See "Identification String" on page 253

SYSTem:LXI:INFo?

This command queries the LXI settings.

Return values:

<LXIInfo> <current version> | <LXI class> | <Computername> | <MAC adress> | <IP adress> | <Auto MDIX>

String containing the current LXI parameters.
- <version>
- <LXIClass>
- <ComputerName>
- <MACAddress>
- <IPAddress>
- <AutoMDIX>

Usage: Query only

Manual operation: See "Current LXI Configuration" on page 256

SYSTem:LXI:LANReset

This command resets the LAN configuration as required by the LXI standard. The command also resets the LXI password and instrument description.

Usage: Event

Manual operation: See "LAN Reset" on page 256

SYSTem:LXI:MDEScription <Description>

This command defines the LXI instrument description.

Parameters:

<Description> String containing the instrument description.

Manual operation: See "LXI Manufacturer Description" on page 256

SYSTem:LXI:PASSword <Password>

This command defines the LXI password.

Parameters:

<Password> String containing the password.

Return values:

<Password> The query returns the current password.

Manual operation: See "LXI Password" on page 256

12.9.6 Checking the System Configuration

Useful commands to check the system configuration described elsewhere:

- `DIAGnostic:SERVice:SINFo?` on page 421

DIAGnostic:INFO:CCOunter?....414
DIAGnostic:SERVice:BIOSinfo?....415
DIAGnostic:SERVice:HWINfo?....415
DIAGnostic:SERVice:VERSinfo?....415
SYSTem:ERRor:CLEar:ALL....416
SYSTem:ERRor:EXTended?....416
SYSTem:ERRor:LIST?....417
SYSTem:ERRor[:NEXT]?....417
SYSTem:FIRMware:UPDate....418
SYSTem:FORMat:IDENt....418
SYSTem:PRESet:COMPatible....418
SYSTem:PRESet:FILTer....419
SYSTem:SECurity[:STATe]....419

DIAGnostic:INFO:CCOunter? <Relay>

This command queries how many switching cycles the individual relays have performed since they were installed.

Query parameters:

<Relay>

ACDC
Mechanical Attenuation Coupling

ATT5
Mechanical Attenuation 05 DB

ATT10
Mechanical Attenuation 10 DB

ATT20
Mechanical Attenuation 20 DB

ATT40
Mechanical Attenuation 40 DB

CAL
Mechanical Calibration Source

EATT
Electrical Attenuation Bypass

PREamp
Preamplifier Bypass

SATT10 | SATT20 | SATT40
Mechanical attenuation (10, 20 and 40 dB) for the optional Signal Source hardware.

SCAL
DUT bypass (available with the optional Signal Source hardware).

Return values:

<Cycles> Number of switching cycles.

Example: `DIAG:INFO:CCO? CAL`

Usage: Query only

Manual operation: See "Relay Cycle Counter" on page 198

DIAGnostic:SERVice:BIOSinfo?

This command queries the BIOS version of the CPU board.

Return values:

<BiosInformation> String containing the BIOS version.

Example: `DIAG:SERV:BIOS?`
Returns the BIOS version.

Usage: Query only

DIAGnostic:SERVice:HWINfo?

This command queries hardware information.

Return values:

<Hardware> String containing the following information for every hardware component.
<component>: name of the hardware component
<serial#>: serial number of the component
<order#>: order number of the component
<model>: model of the component
<code>: code of the component
<revision>: revision of the component
<subrevision>: subrevision of the component

Example: `DIAG:SERV:HWIN?`
Queries the hardware information.

```
"FRONTEND|100001/003|1300.3009|03|01|00|00",
"MOTHERBOARD|123456/002|1300.3080|02|00|00|00",
...
```

Usage: Query only

DIAGnostic:SERVice:VERSinfo?

This command queries information about the hardware and software components.

Return values:

<Information> String containing the version of hardware and software components including the types of licenses for installed options.

Example: DIAG:SERV:VERS?
Queries the version information.
Response:

```
Instrument Firmware |1.10,
BIOS |R&S ANALYZER BIOS V1.80-5-07-1 IPC11,
Image Version |1.6.0,
Device Installation Version |1.0.0,
PCIE-FPGA |13.06,
SA-FPGA |6.46,
MB-FPGA |2.1.3.0,
SYNTH-18G-FPGA |4.8.0.0,
SYNTH-18G-FPGA 2 |4.8.0.0,
REF-FPGA |3.4.0.0,
MWC-FPGA |3.4.0.0,
PNDIGIT-FPGA |0.46,
Data Sheet Version |01.00,
Time Control Management ||active,
Cross Correlation Measurements B60||,
Signal Source B64||,
80 MHz Analysis Bandwidth B80||permanent
```

Usage: Query only
SCPI confirmed

SYSTem:ERRor:CLEar:ALL

This command deletes all contents of the "System Messages" table.

Example: SYST:ERR:CLE:ALL

Usage: Event

SYSTem:ERRor:EXTended? <MessageType>[, <ChannelName>]

This command queries all system messages, or all messages of a defined type, displayed in the status bar for a specific measurement channel (application).

Note: This command queries the strings displayed for manual operation. For remote programs, do not define processing steps depending on these results. Instead, query the results of the STATus:QUEStionable:EXTended:INFO status register, which indicates whether messages of a certain type have occurred (see "STATus:QUEStionable:EXTended:INFO Register" on page 240).

Query parameters:

<MessageType> ALL | INFO | WARNing | ERRor | FATal | MESSage

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Return values:

<Messages> String containing all messages of the selected type for the specified measurement channel. Each message is separated by a comma and inserted in parentheses. If no messages are available, empty parentheses are returned.

Example: `SYST:ERR:EXT? ALL`
Returns all messages for the currently active application, e.g. *"Message 1","Message 2"*.

Example: `SYST:ERR:EXT? FAT,'Spectrum2'`
Queries fatal errors in the 'Spectrum2' application. If none have occurred, the result is: *" "*.

Usage: Query only

SYSTem:ERRor:LIST? [<MessType>]

This command queries the error messages that occur during R&S FSWP operation.

Query parameters:

<MessType> **SMSG**
(default) Queries the system messages which occurred during manual operation.

REMote
Queries the error messages that occurred during remote operation.
Note: The remote error list is automatically cleared when the R&S FSWP is shut down.

Return values:

<SystemMessages> String containing all messages in the "System Messages" table.

<RemoteErrors> <Error_no> | <Description> | <Command> | <Date> | <Time>
Comma-separated list of errors from the "Remote Errors" table, where:
`<Error_no>`: device-specific error code
`<Description>`: brief description of the error
`<Command>`: remote command causing the error
`<Date>|<Time>`: date and time the error occurred

Example: `SYST:ERR:LIST?`

Usage: Query only

SYSTem:ERRor[:NEXT]?

This command queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

For details on error queues see chapter 11.1.7, "Status Reporting System", on page 231.

Usage: Query only

SYSTem:FIRMware:UPDate

This command starts a firmware update using the *.msi files in the selected directory. The default path is `D:\FW_UPDATE`. The path is changed via the `MMEMory:COMMent` command. To store the update files the `MMEMory:DATA` command is used.

Only user accounts with administrator rights can perform a firmware update.

Example: `SYST:FIRM:UPD 'D:\FW_UPDATE'`
Starts the firmware update from directory "`D:\FW_UPDATE`".

Usage: Event

SYSTem:FORMat:IDENt <IDNFormat>

This command selects the response format to the `*IDN?` query.

Parameters:

<IDNFormat>

LEGacy
Format is compatible to R&S FSP/FSU/FSQ/FSG family.

NEW | FSL
R&S FSWP format
Format is also compatible to the R&S FSL and R&S FSV family

*RST: not reset!

Example: `SYST:FORM:IDEN LEG`
Adapts the return value of *IDN? to the R&S FSP/FSU/FSQ family.

Manual operation: See "*IDN Format" on page 254

SYSTem:PRESet:COMPatible <OpMode>

This command defines the operating mode that is activated when you switch on the R&S FSWP or press the PRESET key.

Parameters:

<OpMode>

SANalyzer
(Default:) Defines Signal and Spectrum Analyzer operating mode as the presetting.

*RST: SAN

Usage: Event

Manual operation: See "Preset Mode" on page 191

SYSTem:PRESet:FILTer <FilterType>

This command selects the resolution filter type that is selected after a preset in the Spectrum application.

Parameters:

<FilterType>

NORMal
Selects 3 dB filter.

NOISe
Selects 3 dB filter.
(NORMal and NOISe have the same effect.)

PULSe
Selects 6 dB filter.

*RST: NORMal

Example:

```
SYST:PRES:FILT PULS
```

Selects the 6 dB filters as the default filter type.

SYSTem:SECurity[:STATe] <State>

Activates or queries secure user mode.

Note: Before you activate secure user mode, store any instrument settings that are required beyond the current session, such as predefined instrument settings, transducer files, or self-alignment data.

Note: Initially after installation of the R&S FSWP-K33 option, secure user mode must be enabled manually once before remote control is possible. This is necessary to prompt for a change of passwords.

For details on the secure user mode see chapter 9.2, "Protecting Data Using the Secure User Mode", on page 157.

Parameters:

<State>

ON | OFF | 0 | 1

ON | 1
The R&S FSWP automatically reboots and starts in secure user mode. In secure user mode, no data is written to the instrument's internal solid-state drive. Data that the R&S FSWP normally stores on the solid-state drive is redirected to SDRAM.

OFF | 0
The R&S FSWP is set to normal instrument mode. Data is stored to the internal solid-state drive.
Note: this parameter is for query only. Secure user mode cannot be deactivated via remote operation.

*RST: 0

Manual operation: See "Secure User Mode" on page 191

12.9.7 Using Service Functions

DIAGnostic:SERVice:SFUNction 420
DIAGnostic:SERVice:SFUNction:LASTresult? 420
DIAGnostic:SERVice:SFUNction:RESults:DELete 420
DIAGnostic:SERVice:SFUNction:RESults:SAVE 420
DIAGnostic:SERVice:SINFo? 421

DIAGnostic:SERVice:SFUNction <ServiceFunction>

This command starts a service function.

The service functions are available after you have entered the level 1 or level 2 system password.

Parameters:

<ServiceFunction> String containing the ID of the service function.
The ID of the service function is made up out of five numbers, separated by a point.
- function group number
- board number
- function number
- parameter 1 (see the Service Manual)
- parameter 2 (see the Service Manual)

Usage: Event

Manual operation: See "Service Function" on page 197
See "Send" on page 197

DIAGnostic:SERVice:SFUNction:LASTresult?

This command queries the results of the most recent service function you have used.

Usage: Query only

DIAGnostic:SERVice:SFUNction:RESults:DELete

This command deletes the results of the most recent service function you have used.

Usage: Event

Manual operation: See "Clear Results" on page 197

DIAGnostic:SERVice:SFUNction:RESults:SAVE <FileName>

This command saves the results of the most recent service function you have used.

Parameters:

<FileName> String containing the file name.

Manual operation: See "Save Results" on page 197

DIAGnostic:SERVice:SINFo? <FileName>

This command creates a *.zip file with important support information. The *.zip file contains the system configuration information ("device footprint"), the current eeprom data and a screenshot of the screen display (if available).

This data is stored to the `C:\R_S\Instr\user\` directory on the instrument.

As a result of this command, the created file name (including the drive and path) is returned.

You can use the resulting file name information as a parameter for the `MMEM:COPY` command to store the file on the controller PC.

If you contact the Rohde&Schwarz support to get help for a certain problem, send this file to the support in order to identify and solve the problem faster.

Return values:

<FileName> C:\R_S\Instr\user\<R&S Device ID>_<CurrentDate>_<CurrentTime>

String containing the drive, path and file name of the created support file, where the file name consists of the following elements:
<R&S Device ID>: The unique R&S device ID indicated in the "Versions + Options" information
<CurrentDate>: The date on which the file is created (<YYYYMMDD>)
<CurrentTime>: The time at which the file is created (<HHMMSS>)

Example:

```
DIAG:SERV:SINF?
```

Result:

```
"c:\R&S\instr\user\FSWP-26_1322.8003K26-100005-xx_20130116_165858.zip"
```

```
MMEM:COPY "c:\R&S\instr\user\FSWP-26_
1322.8003K26-100005-xx_20130116_165858.zip",
"S:\Debug\FSWP-26_1322.8003K26-100005-xx_
20130116_165858.zip"
```

Usage: Query only

Manual operation: See "Creating R&S Support Information" on page 193

12.10 Using the Status Register

For more information on the contents of the status registers see:

- "STATus:OPERation Register" on page 236
- "STATus:QUEStionable:ACPLimit Register" on page 238
- "STATus:QUEStionable:EXTended Register" on page 239
- "STATus:QUEStionable:FREQuency Register" on page 240
- "STATus:QUEStionable:LIMit Register" on page 241

- "STATus:QUEStionable:LMARgin Register" on page 242
- "STATus:QUEStionable:POWer Register" on page 242
- "STATus:QUEStionable:TEMPerature Register" on page 244
- "STATus:QUEStionable:TIMe Register" on page 244

- General Status Register Commands 422
- Reading Out the CONDition Part 422
- Reading Out the EVENt Part 423
- Controlling the ENABle Part 424
- Controlling the Negative Transition Part 424
- Controlling the Positive Transition Part 425

12.10.1 General Status Register Commands

STATus:PRESet 422
STATus:QUEue[:NEXT]? 422

STATus:PRESet

This command resets the edge detectors and `ENABle` parts of all registers to a defined value. All `PTRansition` parts are set to `FFFFh`, i.e. all transitions from 0 to 1 are detected. All `NTRansition` parts are set to 0, i.e. a transition from 1 to 0 in a `CONDition` bit is not detected. The `ENABle` part of the `STATus:OPERation` and `STATus:QUEStionable` registers are set to 0, i.e. all events in these registers are not passed on.

Usage: Event

STATus:QUEue[:NEXT]?

This command queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

Usage: Query only

12.10.2 Reading Out the CONDition Part

For more information on the condition part see chapter 11.1.7.2, "Structure of a SCPI Status Register", on page 232.

STATus:OPERation:CONDition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ACPLimit:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:INFO:CONDition? <ChannelName>

STATus:QUEStionable:FREQuency:CONDition? <ChannelName>
STATus:QUEStionable:LIMit<n>:CONDition? <ChannelName>
STATus:QUEStionable:LMARgin<n>:CONDition? <ChannelName>
STATus:QUEStionable:PNOise:CONDition? <ChannelName>
STATus:QUEStionable:POWer:CONDition? <ChannelName>
STATus:QUEStionable:POWer:DCPNoise:CONDition? <ChannelName>
STATus:QUEStionable:TEMPerature:CONDition? <ChannelName>
STATus:QUEStionable:TIME:CONDition? <ChannelName>

These commands read out the CONDition section of the status register.

The commands do not delete the contents of the CONDition section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

12.10.3 Reading Out the EVENt Part

For more information on the event part see chapter 11.1.7.2, "Structure of a SCPI Status Register", on page 232.

STATus:OPERation[:EVENt]?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:ACPLimit[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended:INFO[:EVENt]? <ChannelName>
STATus:QUEStionable:FREQuency[:EVENt]? <ChannelName>
STATus:QUEStionable:LIMit<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:LMARgin<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:PNOise[:EVENt]? <ChannelName>
STATus:QUEStionable:POWer[:EVENt]? <ChannelName>
STATus:QUEStionable:POWer:DCPNoise[:EVENt]? <ChannelName>
STATus:QUEStionable:TEMPerature[:EVENt]? <ChannelName>
STATus:QUEStionable:TIME[:EVENt]? <ChannelName>

These commands read out the EVENt section of the status register.

At the same time, the commands delete the contents of the EVENt section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

12.10.4 Controlling the ENABle Part

For more information on the enable part see chapter 11.1.7.2, "Structure of a SCPI Status Register", on page 232.

STATus:OPERation:ENABle <SumBit>
STATus:QUEStionable:ENABle <SumBit>
STATus:QUEStionable:ACPLimit:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:PNOise:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:DCPNoise:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:ENABle <SumBit>,<ChannelName>

These commands control the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

12.10.5 Controlling the Negative Transition Part

For more information on the positive transition part see chapter 11.1.7.2, "Structure of a SCPI Status Register", on page 232.

STATus:OPERation:NTRansition <SumBit>
STATus:QUEStionable:NTRansition <SumBit>
STATus:QUEStionable:ACPLimit:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:PNOise:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:DCPNoise:NTRansition <SumBit>,<ChannelName>

STATus:QUEStionable:TEMPerature:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:NTRansition <SumBit>,<ChannelName>

These commands control the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

12.10.6 Controlling the Positive Transition Part

For more information on the negative transition part see chapter 11.1.7.2, "Structure of a SCPI Status Register", on page 232.

STATus:OPERation:PTRansition <SumBit>
STATus:QUEStionable:PTRansition <SumBit>
STATus:QUEStionable:ACPLimit:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:PNOise:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:DCPNoise:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:PTRansition <SumBit>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

12.11 Programming Examples

Some advanced programming examples for complex measurement tasks are provided here.

- Programming Example: Performing a Basic Frequency Sweep 426
- Service Request 428

12.11.1 Programming Example: Performing a Basic Frequency Sweep

This example demonstrates how to configure and perform a basic frequency sweep measurement in a remote environment.

```
//--------------Preparing the measurement ---------------------
*RST
//Resets the instrument
INIT:CONT OFF
//Selects single sweep mode.

//--------------Configuring the Frequency and Span-------------
FREQ:CENT 100MHz
//Defines the center frequency
FREQ:SPAN 200MHz
//Sets the span to 100 MHz on either side of the center frequency.

//Activate signal tracking to keep the center frequency on the signal peak:
CALC:MARK:FUNC:STR ON
CALC:MARK:FUNC:STR:BAND 20MHz
CALC:MARK:FUNC:STR:THR -90dBm
CALC:MARK:FUNC:STR:TRAC 1
//After each sweep the maximum on trace 1 is searched within a range of 20 MHz
//around the center frequency. It must have a minimum power of -90dBm.

//--------------Configuring the Bandwidth----------------------
BAND:AUTO OFF
BAND 1MHz
BAND:TYPE RRC
//Defines the RBW as 1 MHz using an RRC filter

BAND:VID:AUTO OFF
BAND:VID 500kHz
//Decouples the VBW from the RBW and decreases it to smooth the trace.

//--------------Configuring the Sweep--------------------------
SENS:SWE:COUN 10
//Defines 10 sweeps to be performed in each measurement.
SENS:SWE:POIN 500
//During each sweep, 500 trace points will be measured.
SENS:SWE:TIME:AUTO OFF
```

```
SENS:SWE:TIME 50ms
//Decouples the sweep time from the RBW,VBW and span and increases it to
//make the measurement more precise.

//--------------Configuring Attenuation-------------------------
//Only if electronic attenuator is available:
//INP:EATT:STAT ON
//Switches on the electronic attenuator.
//INP:EATT 30dB
//Sets the electronic attenuation to 30 dB.
INP:ATT 10dB
//Sets the mechanical attenuation to 10 dB and couples the reference level
//to the attenuation instead of vice versa.

//--------------Configuring the Amplitude and Scaling----------
DISP:TRAC1:Y:RLEV -10dBm
//Sets the reference level to -10 dBm.
DISP:TRAC1:Y:RLEV:OFFS 10dB
//Shifts the trace display in the diagram up by 10dB.
CALC:UNIT:POW V
//Sets the unit of the y-axis to Volt. The reference level is now 70.711 mV.
DISP:TRAC1:Y:SPAC LOG
//Uses logarithmic scaling with absolute values (V).
DISP:TRAC1:Y 110dB
//Increases the displayed range of the y-axis to 110 dB.
DISP:TRAC1:Y:RPOS 80PCT
//Shifts the display of the reference level down, it is no longer the top line
//in the diagram. The reference level is displayed as a red line.

//--------------Triggering-----------------------------------
TRIG:SOUR IFP
TRIG:LEV:IFP -10dBm
TRIG:SLOP POS
TRIG:DTIM 50ms
TRIG:IFP:HYST 5dB
TRIG:HOLD 10ms
//Defines triggering when the second intermediate frequency rises to a level
//of -10 dBm, with a dropout time of 50 ms, a hysteresis of 5 dB and a delay
//of 10 ms.


SWE:EGAT ON
SWE:EGAT:TYPE EDGE
SWE:EGAT:LENG 5ms
//Defines gating. Values are measured for 5 ms after triggering.

OUTP:TRIG2:DIR OUTP
OUTP:TRIG2:OTYP UDEF
OUTP:TRIG2:LEV HIGH
OUTP:TRIG2:PULS:LENG 100us
```

```
OUTP:TRIG2:PULS:IMM
//Configures a high trigger signal with a pulse length of 100 us to be output at
//the front TRIGGER INPUT/OUTPUT connector once.

//--------------Configuring the Trace--------------------------
DISP:TRAC2 ON
DISP:TRAC2:MODE AVER
DISP:TRAC3 ON
DISP:TRAC3:MODE MAXH
//Configures 3 traces: 1 (default): clear/write; 2: average; 3: max hold

SENS:DET1 POS
SENS:DET2 RMS
SENS:DET3 POS
//Configures traces 1 and 3 to use the positive peak detector; trace 2 uses
//the RMS detector.

TRAC:COPY TRACE4,TRACE1
//Copies trace 1 to a new trace 4 which will then be averaged.

SENS:AVER:STAT4 ON
SENS:AVER:COUN 10
SENS:AVER:TYPE LIN
//Configures trace 4 to be averaged linearly over 10 sweeps.

CALC:MATH:STAT ON
CALC:MATH:MODE LIN
CALC:MATH (TRACE1-TRACE2)
CALC:MATH:POS 100
//Calculates the linear difference between the measured and average values.
//The resulting trace is displayed at the top of the diagram.

//--------------Performing the Measurement---------------------
INIT;*WAI
//Initiates a new measurement and waits until the last sweep has finished.

//---------------Retrieving Results-----------------------------
TRAC:DATA? TRACE1
TRAC:DATA? TRACE2
TRAC:DATA? TRACE3
TRAC:DATA? TRACE4
//Returns one power and one frequency value per sweep point for each trace.
```

12.11.2 Service Request

The service request routine requires an extended initialization of the instrument in which the relevant bits of the transition and enable registers are set. In addition the service request event must be enabled in the VISA session.

12.11.2.1 Initiate Service Request

```
REM ---- Example of initialization of the SRQ in the case
' of errors -------
PUBLIC SUB SetupSRQ()
CALL InstrWrite (analyzer, "*CLS") 'Reset status reporting system
CALL InstrWrite (analyzer, "*SRE 168") 'Enable service request for
'STAT:OPER, STAT:QUES and ESR
'register
CALL InstrWrite (analyzer, "*ESE 60") 'Set event enable bit for
'command, execution, device-
'dependent and query error
CALL InstrWrite (analyzer, "STAT:OPER:ENAB 32767")
'Set OPERation enable bit for
'all events
CALL InstrWrite (analyzer, "STAT:OPER:PTR 32767")
'Set appropriate OPERation
'Ptransition bits
CALL InstrWrite (analyzer, "STAT:QUES:ENAB 32767")
'Set questionable enable bits
'for all events
CALL InstrWrite (analyzer, "STAT:QUES:PTR 32767")
'Set appropriate questionable
'Ptransition bits
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
'Enable the event for service
'request
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
 VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq
'If SRQ is recognized =>
'subroutine for evaluation
END SUB
REM ************************************************************************
```

12.11.2.2 Waiting for the Arrival of a Service Request

There are basically two methods of waiting for the arrival of a service request:

Blocking (user inputs not possible):

This method is appropriate if the waiting time until the event to be signaled by an SRQ is short (shorter than the selected timeout), if no response to user inputs is required during the waiting time, and if – as the main criterion – the event is absolutely certain to occur.

Reason:

From the time the viWaitOnEvent() function is called until the occurrence of the expected event, it does not allow the program to respond to mouse clicks or key entries dur-

ing the waiting time. Moreover, it returns an error if the SRQ event does not occur within the predefined timeout period.

The method is, therefore, in many cases not suitable for waiting for measurement results, especially when using triggered measurements.

The following function calls are required:

```
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
 VI_NULL)
'Wait for service request user
'inputs are not possible during
'the waiting time!
IF (status = VI_SUCCESS) THEN CALL Srq
'If SRQ is recognized =>
'subroutine for evaluation


'--------- Sweep in first Spectrum Tab and query marker --------------------
Dim Status = mbSession.WaitOnEvent( _
MessageBasedSessionEventType.ServiceRequest, SRQWaitTimeout)
'Wait for service request user inputs are not possible
'during the waiting time!
If (Status.EventType() = MessageBasedSessionEventType.ServiceRequest) Then
'If SRQ is recognized => subroutine for evaluation
    Srq()
End If
```

Non-blocking (user inputs possible):

This method is recommended if the waiting time until the event to be signaled by an SRQ is long (longer than the selected timeout), and user inputs should be possible during the waiting time, or if the event is not certain to occur. This method is, therefore, the preferable choice for waiting for the end of measurements, i.e. the output of results, especially in the case of triggered measurements.

The method necessitates a waiting loop that checks the status of the SRQ line at regular intervals and returns control to the operating system during the time the expected event has not yet occurred. In this way, the system can respond to user inputs (mouse clicks, key entries) during the waiting time.

It is advisable to employ the Hold() auxiliary function, which returns control to the operating system for a selectable waiting time (see section Waiting Without Blocking the Keyboard and Mouse), so enabling user inputs during the waiting time.

```
result% = 0
For i = 1 To 10 'Abort after max. 10 loop
'iterations
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_TMO_IMMEDIATE, VI_NULL,
 VI_NULL)
'Check event queue
If (status = VI_SUCCESS) Then
result% = 1
CALL Srq 'If SRQ is recognized =>
```

```
'subroutine for evaluation
Else
CALL Hold(20) 'Call hold function with
'20 ms 'waiting time. User inputs
'are possible.
Endif
Next i
If result% = 0 Then
Debug.Print "Timeout Error; Program aborted"'Output error message
STOP 'Stop software
Endif
```

12.11.2.3 Waiting Without Blocking the Keyboard and Mouse

A frequent problem with remote control programs using Visual Basic is to insert waiting times without blocking the keyboard and the mouse.

If the program is to respond to user inputs also during a waiting time, control over the program events during this time must be returned to the operating system. In Visual Basic, this is done by calling the `DoEvents` function. This function causes keyboard-or mouse-triggered events to be executed by the associated elements. For example, it allows the operation of buttons and input fields while the user waits for an instrument setting to be completed.

The following programming example describes the `Hold()` function, which returns control to the operating system for the period of the waiting time selectable in milliseconds.

```
Rem ***************************************************************************
Rem The waiting function below expects the transfer of the desired
Rem waiting time in milliseconds. The keyboard and the mouse remain
Rem operative during the waiting period, thus allowing desired elements
Rem to be controlled
Rem ***************************************************************************
Public Sub Hold(delayTime As Single)
Start = Timer 'Save timer count on calling the
'function
Do While Timer < Start + delayTime/1000 'Check timer count
DoEvents 'Return control to operating
'system to enable control of
'desired elements as long as
'timer has not elapsed
Loop
End Sub
Rem ***************************************************************************
```

The waiting procedure is activated simply by calling `Hold(<Waiting time in milliseconds>)`.

12.11.2.4 Service Request Routine

A service request is processed in the service request routine.

The variables userN% and userM% must be pre-assigned usefully!

```
REM ------------ Service request routine ---------------------------------
Public SUB Srq()
ON ERROR GOTO noDevice 'No user existing
CALL viReadSTB(analyzer, STB%) 'Serial poll, read status byte
IF STB% > 0 THEN 'This instrument has bits set in
'the STB
SRQFOUND% = 1
IF (STB% AND 16) > 0 THEN CALL Outputqueue
IF (STB% AND 4) > 0 THEN CALL ErrorQueueHandler
IF (STB% AND 8) > 0 THEN CALL Questionablestatus
IF (STB% AND 128) > 0 THEN CALL Operationstatus
IF (STB% AND 32) > 0 THEN CALL Esrread
END IF
noDevice:
END SUB 'End of SRQ routine
REM ************************************************************************

REM ---------- Subroutine for evaluation Service Request Routine ----------

Public Sub Srq()
    Try
        Dim mySTB As Short = mbSession.ReadStatusByte()
                             'Serial poll, read status byte
        Console.WriteLine("Reading Service Request Routine:" + mySTB.ToString())
        If mySTB > 0 Then 'This instrument has bits set in the STB
            If (mySTB And 16) > 0 Then Call Outputqueue()
            If (mySTB And 4) > 0 Then Call ErrorQueueHandler()
            If (mySTB And 8) > 0 Then Call Questionablestatus()
            If (mySTB And 128) > 0 Then Call Operationstatus()
            If (mySTB And 32) > 0 Then Call Esrread()
        End If
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub 'End of SRQ routine
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

12.11.2.5 Reading Out the Output Buffer

```
REM -------- Subroutine for the individual STB bits -----------------------
Public SUB Outputqueue() 'Reading the output buffer
result$ = SPACE$(100) 'Make space for response
CALL InstrRead(analyzer, result$)
Debug.Print "Contents of Output Queue:"; result$
END SUB
REM ***************************************************************************

REM -------- Subroutine for the output queue -----------------------
Public Sub Outputqueue() 'Reading the output buffer
    Try
        Dim result As String = mbSession.ReadString()
        Console.WriteLine("Contents of Output Queue:" + result)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

12.11.2.6 Reading Error Messages

```
REM -------- Subroutine for reading the error queue -----------------------
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100) 'Make space for error variable
CALL InstrWrite (analyzer, "SYSTEM:ERROR?")
CALL InstrRead(analyzer, ERROR$)
Debug.Print "Error Description:"; ERROR$
END SUB
REM ***************************************************************************

REM -------- Subroutine for reading the error queue -----------------------
Sub ErrorQueueHandler()
    Dim result As String
    Dim hasErr As Boolean = True
    Do
        mbSession.Write("SYST:ERR?")
        result = mbSession.ReadString()
        Dim parts As String() = result.Split(",")
        If parts(0) = 0 Then
            hasErr = False
            Console.WriteLine(result)
        Else
            Console.WriteLine(result)
        End If
    Loop While hasErr
End Sub
```

12.11.2.7 Evaluation of SCPI Status Registers

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public SUB Questionablestatus()
Ques$ = SPACE$(20)
'Preallocate blanks to text
'variable
CALL InstrWrite (analyzer, "STATus:QUEStionable:EVENt?")
CALL InstrRead(analyzer, Ques$)
Debug.Print "Questionable Status:"; Ques$
END SUB
REM ************************************************************************
REM ------ Subroutine for evaluating Operation Status Register ------------
Public SUB Operationstatus()
Oper$ = SPACE$(20) 'Preallocate blanks to text
'variable
CALL InstrWrite (analyzer, "STATus:OPERation:EVENt?")
CALL InstrRead(analyzer, Oper$)
Debug.Print "Operation Status:"; Oper$
END SUB
REM ************************************************************************
```

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public Sub Questionablestatus()
    Dim myQSR As String = Nothing
    Try
        myQSR = mbSession.Query("STATus:QUEStionable:EVENt?") 'Read QSR
        Console.WriteLine("Questionable Status:" + myQSR)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub

REM ------ Subroutine for evaluating Operation Status Register ------------
Public Sub Operationstatus()
    Dim myOSR As String = Nothing
    Try
        myOSR = mbSession.Query("STATus:OPERation:EVENt?") 'Read OSR
        Console.WriteLine("Operation Status:" + myOSR)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

12.11.2.8 Evaluation of Event Status Register

```
REM ------ Subroutine for evaluating the Event Status Register ------------
Public SUB Esrread()
Esr$ = SPACE$(20) 'Preallocate blanks to text
'variable
```

```
CALL InstrWrite (analyzer, "*ESR?") 'Read ESR
CALL InstrRead(analyzer, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN Debug.Print "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN Debug.Print "Request Control"
IF (VAL(Esr$) AND 4) > 0
THEN Debug.Print "Query Error"
IF (VAL(Esr$) AND 8) > 0
THEN Debug.Print "Device dependent error"
IF (VAL(Esr$) AND 16) > 0
THEN Debug.Print "Execution Error; Program aborted"'Output error message
STOP 'Stop software
END IF
IF (VAL(Esr$) AND 32) > 0
THEN Debug.Print "Command Error; Program aborted"'Output error message
STOP 'Stop software
END IF
IF (VAL(Esr$) AND 64) > 0 THEN Debug.Print "User request"
IF (VAL(Esr$) AND 128) > 0 THEN Debug.Print "Power on"END SUB
REM ********************************************************************

REM ------ Subroutine for evaluating the Event Status Register ------------
Public Sub Esrread()
    Try
        Dim myESR As Short = mbSession.Query("*ESR?") 'Read ESR
        If (myESR And 1) > 0 Then Console.WriteLine("Operation complete")
        If (myESR And 2) > 0 Then Console.WriteLine("Request Control")
        If (myESR And 4) > 0 Then Console.WriteLine("Query Error")
        If (myESR And 8) > 0 Then Console.WriteLine("Device dependent error")
        If (myESR And 16) > 0 Then
            Console.WriteLine("Execution Error; Program aborted") 'Output error message
            Stop 'Stop software
        End If
        If (myESR And 32) > 0 Then
            Console.WriteLine("Command Error; Program aborted") 'Output error message
            Stop 'Stop software
        End If
        If (myESR And 64) > 0 Then Console.WriteLine("User request")
        If (myESR And 128) > 0 Then Console.WriteLine("Power on")
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

List of Commands

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